

THE BACK-END OF THE NUCLEAR FUEL CYCLE IN GERMANY AFTER THE AGREEMENT BETWEEN THE FEDERAL GOVERNMENT AND THE UTILITIES

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ABSTRACT

The presentation will explain the history and the latest developments of the back-end of the nuclear fuel cycle in Germany. Especially the transitions and changes after the election in September 1998. The new coalition decided in their program to phase-out the use of nuclear energy comprehensively and irreversibly by law within this legislative period. After a long negotiation period an Agreement between the Government and the utilities was reached. The details and the consequences of this Agreement are explained.

INTRODUCTION

Germany, as a highly developed industrial country in Europe, started the peaceful use of nuclear energy in the 1960's. At this time the use of nuclear energy was not controversial between the political parties and the industry. But soon a debate started over whether using nuclear energy in our country is a responsible policy and this led to a weighty and contentious discussion.

Today Germany is one of Europe's largest electricity markets fueled by coal (54%), nuclear power (30%) natural gas (9%), hydro (4 %) and oil (3 %).

At present Germany has 19 nuclear reactors, which supply 30 % of the country's electricity. Most of the units are large reactors of greater than 1000 MWe capacity. The latest reactor (Neckarwestheim) came into operation in 1989 (Figure 1).

German reactors have an excellent operating record. The Isar 2 reactor was the world leader for electricity generation at 12,268 GWh in 1999. Other reactors like Grohnde, Brokdorf and Philippsburg were world leaders in previous years.

In the former GDR (East Germany), the five Soviet designed reactors were shut down for safety reasons in 1990 and are being decommissioned.

To understand the German nuclear fuel cycle situation, especially the back-end, it is necessary to be aware of its historical development. Therefore, an overview of the historical development of the German nuclear industry is a good starting point.

HISTORICAL BACKGROUND

As early as 1958, research on the reprocessing of spent fuel had started, mainly driven by the chemical industry, which believed that the recycling of uranium and plutonium would create great economical value. The first reactor commenced operation in 1961. The first plutonium fuel fabrication was launched in 1963. 1967 saw the final repository in the salt dome of Asse become operational and in 1971 reprocessing in the Karlsruhe pilot plant started. All this led at the beginning of the 70s to the closed nuclear fuel cycle becoming a reality in Germany on a small pre-industrial scale. It was commonly understood by the industry and politicians that the nuclear industry would be further developed to become a major electricity supply source and that, in order to be independent of energy imports, every part of the nuclear fuel cycle industry had to be established in Germany.

Consequently in 1976 the German government asked the utilities to develop a nuclear center in which all fuel cycle back-end activities should be concentrated. The Gorleben site was selected because an undisturbed underground salt dome beneath the site promised to be suitable for the final disposal of all radioactive wastes especially high active waste.

By then it became obvious, however, that the chemical industry had lost its interest in recycling, so the responsibility for the establishment of a nuclear fuel cycle industry was passed to the utilities. In order to motivate the industry to establish the recycling industry rapidly the government required - as a precondition for nuclear operation - the proof that spent nuclear fuel could be treated properly. As evidence contracts or operating facilities had to exist that gave the certainty that the fuel to be discharged in the next six years was covered. In order to fulfill this obligation the utilities decided that in advance of the availability of the recycling center at Gorleben, reprocessing contracts had to be signed with Cogema and BNFL. So the Utilities signed the so-called Service Agreements with COGEMA between 1978 and 1980 and with BNFL in 1983.

In 1979 the responsible politicians decided that the Gorleben reprocessing facility had to be cancelled due to a lack of general political support. Only facilities for interim spent fuel storage, for spent fuel treatment and the final repository were considered politically feasible at Gorleben.

The German utilities down-sized their national reprocessing capacity requirement to 350 t HM/a for a plant to be built in Wackersdorf, Bavaria and decided together with Siemens to enlarge the pilot MOX fabrication facility in Hanau to 120 t HM/a. At the same time the utilities decided to develop the back-end route of direct disposal of spent nuclear fuel, in order to have this technology available as an alternative to fuel recycling.

A detailed study by a public institution was performed which demonstrated that from the safety perspective there was no disadvantage in direct fuel disposal compared to the closed nuclear fuel cycle. Consequently the German utilities in 1985 decided to plan and build the pilot spent fuel treatment plant (PKA) at Gorleben.

However, in 1989 the reprocessing plant project at Wackersdorf proved to be much more expensive than expected. At the same time it became obvious that Cogema's and BNFL's reprocessing facilities would not be completely used by their respective domestic reprocessing requirements. By then the idea of the European Community - just a grand vision in the 60's - seemed to be becoming more and more a reality, and so the goal of national independence on all nuclear fuel cycle activities was no longer pursued. Therefore the utilities decided to give up the Wackersdorf project. In order to fulfill the legal requirement of proving six years in advance what to do with spent nuclear fuel, additional reprocessing capacities in Cogema's and BNFL's facilities were reserved by the German utilities.

Another deep break in the peaceful use of nuclear energy in Germany happened due to the politically motivated abandonment of the MOX-fuel fabrication at Hanau in early 1994. With this decision, all attempts to build up a German recycling industry had finally failed. After this development the German government changed the Atomic Law in 1994, and gave up the recycling of nuclear material as the only legal route for disposal of spent fuel in Germany.

Already in 1992 to 1994 as a consequence of discussions between the Government, utilities and Trade Unions there was a general agreement, that new NPP would not be built before a "General consensus" between all parties involved was found.

In summary this historical development can be subdivided into 3 phases:

- The “promotion period” between 1956 and 1978 during which nuclear energy was predicted to have a great future. The German Government (also the Social-Democrats) supported the nuclear industry. This led to introduction of the German Atomic Law with its promotion clause. A plan was established to realize a closed fuel cycle (reprocessing, MOX-fabrication) in Germany. Also at this time the question regarding the selection of a geological disposal site was to be solved quickly.
- 1978 until 1989: The back-end or disposal concept of the Federal Government, which was a result of the provisions in the Atomic Law, was signed between all Federal States (Laender) and the Government in 1979. This backend-concept was taken for granted by all Federal states and the Government and was and is from a legal point of view still the basis for the back-end and disposal in German. The forecasts for the peaceful use of nuclear energy were down-rated to a lower value. A high availability of the NPP and low production costs (also because of the low prices for uranium) were demonstrated in Germany. The TMI-2 accident in 1979 and the Chernobyl-accident in 1986 had a strong influence on public opinion regarding the use of nuclear industry in Germany. Also in this period a constitution of Non-government-organizations (NGO) like Greenpeace Germany, The BUND, The Greens et al came into being. These organizations used the topic “Nuclear Business” as a platform to mobilize people and find greater influence within politics. Their influence grew with time. One example is the change of the Green-Party in Germany from a NGO to a Party, to a Party with influence in some states (Laender) and finally as a Federal Government Party since 1998. Also the Social Democrats (SPD) decided in 1986 – after the Chernobyl-accident - to phase-out the peaceful use of nuclear energy in Germany within 10 years.
- **1989 until 1998:** The utilization of nuclear energy is held back by the relevant authorities especially on the part of the Federal States (Laender). The political parties especially the opposition delay nuclear projects like the pilot spent fuel treatment plant (PKA), the final repository Konrad and the new MOX fabrication plant in Hanau. The transports within Germany – from a NPP to the central interim storage facilities Gorleben or Ahaus - are the main focus of the anti-nuclear demonstrations. Thousands of people demonstrate against these transports even though they result from giving up reprocessing transports. Such a demonstration was lead by Mr. Schroeder, today's German chancellor. To solve the increasing controversy Government and nuclear industry started their first endeavors in 1992 to find a consensus regarding the use of nuclear energy. But this attempt failed as did the second in 1995.

After 1998 a new phase with a dramatic change in policy regarding the use of nuclear energy in Germany started.

It began with the so-called contamination-affair. It was announced in May 1998 that on some shipments of spent fuel to La Hague and Sellafield higher contamination than 4 Bq/cm^2 were measured. These contamination values with very low radiation doses do not have any negative health effects for people. This was later confirmed also by the Ministry of Environment. But these contamination led to a stop of all spent fuel transports from Germany to France and the UK.

Chronology of the German Nuclear phase-out since 1998

In September 1998 – after 16 years of a Conservative government – the Social Democrats together with the Greens won the election in Germany. This coalition decided in their program to phase-out the use of nuclear energy comprehensively and irreversibly by law within this legislative period. In their first program the following steps were mentioned, for example:

- Deletion of the promotion clause
- Limitation of spent fuel disposition to direct final storage (prohibition of reprocessing)
- Repeal of the 1998 amendment to the Atomic Energy Act (with the exception of transposition of EU law)

The new Government tried very hard to establish this new energy policy. For instance the Minister for Environment, Mr. Trittin, wanted to ban reprocessing from 1999. But because of the international liability with COGEMA/France and BNFL/UK this route was ruled out by the French and English governments.

The Government had to realize that energy policy is a long term project. Therefore a long journey of discussions, meetings and negotiations started. The following highlights the most important steps, which finally led to an agreement:

January 1999: First meeting between Chancellor Schroeder and the CEOs of the four largest nuclear power companies start up the so-called “Energy Consensus Talks”.

A preliminary meeting led to the declaration of 5 points:

- The intention to end the use of nuclear power in Germany is accepted by the German utilities primarily for political reasons.
- Operation of NPPs is to be ensured by an agreement on the guaranteed remaining operational lifetime until the complete end to the use of nuclear power.
- The ban of reprocessing is to be accepted. Cancellation of reprocessing contracts can only be realized without compensation if the possibility of local storage is technically realized and after a legal decision is agreed between government and German utilities that it is a reliable way of disposal for the remaining operational lifetime.
- After this way of disposal is established the German utilities shall use all contractual possibilities to finish reprocessing.
- Details are to be agreed in a working group. The time needed to abandon reprocessing will be agreed.

March 1999: After a meeting between Chancellor Schroeder and the four CEOs – which failed to come to any resolution – a working group was established to solve the question of taxing the financial reserves (provisions) of the German nuclear utilities.

July 1999: The Government postponed the nuclear phase-out solution until the summer break. A working group with only representatives from the Ministries were charged with finding a solution for a compensations free phase-out, by September 1999.

January 2000: The German Government unilaterally defined a basis for the next consensus talks with the utilities.

February 2000: The fourth meeting between Chancellor Schroeder and the CEOs set up a new working group to find and formulate concrete proposals.

March to June 2000: Many meetings of the working group were held.

14. June 2000: The Federal Government and the German nuclear utilities concluded an agreement on the phase-out of the use of nuclear energy.

The main results of this mutual agreement on discontinuing the use of nuclear energy can be divided into four areas:

- Limited operational lifetime of existing reactors (32 calendar years)
- Operation of reactors during their remaining lifetimes (periodic safety review)
- Waste Management (ban on reprocessing, interim storage, final disposal)
- Revision of Atomic Law

Limited operational lifetime of existing reactors

Each NPP can produce a quantity of electrical power, which was calculated on the basis of a normal life time of 32 calendar years from the start of operation. As an example: NPP Stade, which is now in the news, started commercial operation in 1972 and can therefore produce electricity until 2004. In September 2000 E.ON as the owner decided to shut down NPP Stade in 2003. That part of the agreed electricity output not produced can then be transferred to another NPP, for instance to Unterweser or Grohnde. The NPP's which started operation at the end of the 1980's (Brokdorf, Emsland, Neckarwestheim) can produce until 2021. These dates give a practical indication of the "phase-out" of nuclear.

Periodic Safety Review

The utilities agreed to carry out regular safety checks. The checks should be repeated every 10 years and will be conducted on the basis of the current PSU manual. Details will be agreed in the Nuclear Energy Act.

Waste Management (ban on reprocessing, interim storage, final disposal)

The following points were agreed:

- The utilities shall build temporary storage facilities as quickly as possible at the nuclear power station sites. The companies will also jointly explore the possibilities of creating provisional storage facilities at the sites before start-up of the temporary stores. These procedures are under way.
- Transport to reprocessing plants is permissible until 01.07.2005. The Federal Government, the Federal States (Laender) and the utilities set-up a standing co-ordination group to re-establish spent fuel transports. The group has already had two meetings. The German utilities hope that they are close to a first transport to La Hague. One problem is the so-called injunction "first HAW (glass from reprocessing) from France, then spent fuel to France".
- Final disposal: The survey of the Gorleben salt dome will be interrupted for at least three but not more than 10 years, until various design and safety questions are clarified. In order to save the Gorleben project the Federal Government has made a declaration concerning the survey of the Gorleben salt dome, which is an appendix to the Agreement. Also the Konrad permanent repository will be further pursued. The plan approval for the Konrad repository will be given without ordering immediate enforcement.

Revision of Federal Nuclear Law

The Federal Government intends to amend the Nuclear Energy Act. This Amendment will incorporate various points as identified in another appendix to the Agreement. The finalization of the law will be discussed between the German utilities and the Government before a cabinet decision is made. (Only) After the Revision of the Nuclear Law do the German utilities intend to sign this agreement.

WHAT DO THE GERMAN UTILITIES EXPECT FROM THIS AGREEMENT WITH THE GOVERNMENT

Since 1998 the liberalization/deregulation of the energy market in Germany has been underway. You are certainly aware of all the problems such a new market situation means for the utilities. In addition the new Government came up with the "phase-out" of nuclear energy in Germany. To preserve our capital (investment) we needed new conditions to be accepted in this Agreement for the reliable long term operation of our NPP's.

We must accept the primacy of the political decisions especially for the energy supply of Germany, however we do not believe that phasing-out nuclear energy is the right decision. We are convinced that an energy mix would be a much more responsible solution for Germany.

In this Agreement the Federal Government promised, that the operation and the back-end of our NPP will not be hindered or obstructed by politically motivated actions. The Government also promised to guarantee a viable waste management route for the NPP. That means that transport to the reprocessing plants in France and UK will start as soon as possible and can continue until July 2005 or until the interim storage facilities at the reactor sites are available.

In summary the German utilities accept this agreement as:

- a settlement to regulate the operation of the NPP
- securing of economical frame work
- a public guarantee for the back-end.

REGARDING THE BACK-END: WHERE WE ARE NOW AFTER A FEW MONTHS OF THE AGREEMENT

First and most important is the issue of "spent fuel shipments". To carry out the forthcoming refueling outages as a pre-condition for running the plants, spent fuel transportation is necessary. If the reloads cannot be carried out, plants have to be shut down until space becomes available in the ponds. Several plants will be in this situation at the beginning of 2001. In the late fall of 2000 the utilities received all necessary licenses and approvals from the German authorities for the transport of spent fuel. But this time it was the French Government, which refused the shipments to the reprocessing plant in France. They declared that at first Germany had to take back the HAW-glass from reprocessing, which was to be returned to Germany over two years ago. Also the German Government in co-operation (collaboration) with the involved Federal States (Laender) always found obstacles to prevent the return of waste to interim storage at Gorleben. Examples of such obstacles are the reconstruction of a railway bridge and the refusal to approve an alternative route.

The latest development in this story is a transportation schedule for March/April 2001. This could be too late for some NPP's should the French Government insist on "First HAW to Gorleben then Spent fuel to France".

As mentioned before shipments to a reprocessing plant will be prohibited after July 2005. Moreover, it was agreed to cease the use of the central interim storage in Ahaus (420 flasks; only 10% used) and Gorleben (420 flasks; foreseen mainly for glass from reprocessing in France and UK). Consequently the utilities have to build new storage facilities at the reactor sites. All utilities applied for such facilities and the Federal Agency for Radiation Protection is responsible for granting the license. In addition to the atomic license, a building permit granted by the local administrations is also necessary. Furthermore the local parties and institutions do not at all favor interim storage at their locations. It seems that the German utilities are facing additional problems in order to get the license in time.

Because of the problems with delayed shipments and the hold up of interim storage facilities at the reactor sites, a few German utilities applied for so-called intermediate or provisional storage at reactor sites. This means storing the flasks under a moveable cover, like a garage. The utilities have applied for this interim solution (often called “the garage solution”) until the long term interim storage facilities become available (2005).

The Ministry for Environment decided for this application a long and complex procedure including public inquiries. This request does not help use the garage solution as a quick-fix until the storage facilities becoming available.

The last step in the back-end, is the final geological disposal site. In Germany, we have already reached a well-known status. Morsleben was used for a few years as the final geological disposal site of solid low level wastes. The Konrad repository, foreseen for low-active, non-heat generating waste, is close to obtaining a license for operation. The German utilities have already spent \$ 0,6 Billion US for Konrad. It was agreed to grant the license but, not to use it within the next 3 to for 4 years until all legal questions have been resolved.

A moratorium has been placed on the Gorleben final repository project, on which the utilities have already spent more than \$1,1 billion US. The Federal Government raised problematic issues, which in our opinion do not justify a moratorium. The Gorleben site has been investigated to an extremely detailed level in response to the Government.

For this reason the utilities demanded the following statement about the Gorleben final repository in an appendix to the Agreement of 14th July, in which it was declared that the geological research at the Gorleben site does not contradict the thesis that the Gorleben salt dome is a suitable site for disposal of radioactive waste. Furthermore it was agreed that the Federal Government will take the necessary measures to maintain the Gorleben site during the moratorium.

Status quo

Half a year after the Agreement there is no movement toward the agreed direction to help the utilities to keep their NPP's in operation:

- No shipments of spent fuel either to France or to the UK. The storage capacities in the ponds of the NPP will be exhausted with the next reloads.
- Utilities applied for interim storage facilities at the reactor sites. The legal procedure (Atomic Law and building permit) is very time-consuming. If as agreed the shipments will cease from July 2005 onwards the storage facilities may not be available in time.
- The Government stopped the Gorleben permanent repository but did not achieve any progress regarding the approval for the Konrad repository.

It will be very difficult for the Government to realize the agreed points. In 2002, the next Federal election will be held in Germany. That means the next election campaign with political promises will start as early as 2001.

The next months will indicate if it is possible to reach a “consensus” on nuclear energy in Germany.

Table I: NPP's in Germany

Unit	Lead Utility or Fuel Buyer	Type	COD	Capacity (MWe net)	Total 1999 Electricity Generation (GWh net)
Obrigheim 1	Kernkraftwerk Obrigheim GmbH	PWR	Mar 69	340,00	2,959
Stade	E.ON Kernkraft GmbH	PWR	Mai 72	630,00	4,875
Biblis A	RWE Power AG	PWR	Feb 75	1.146,00	7,720
Neckarwestheim 1	Gemeinschaftkernkraftwerk Neckar	PWR	Dec 76	785,00	6,291
Biblis B	RWE Power AG	PWR	Jan 77	1.240,00	9,309
Brunsbüttel	Hamburgische Electricitäts-Werke AG	BWR	Feb 77	771,00	6,483
Isar 1	E.ON Kernkraft GmbH	BWR	Mar 79	870,00	7,830
Unterweser	E.ON Kernkraft GmbH	PWR	Sep 79	1.255,00	8,519
Philippsburg 1	EnBW AG	BWR	Feb 80	926,00	7,226
Grafenrheinfeld	E.ON Kernkraft GmbH	PWR	Jun 82	1.275,00	8,838
Krömmel	Hamburgische Electricitäts-Werke AG	BWR	Mar 84	1.260,00	10,955
Gundremmingen B	RWE Power AG	BWR	Jul 84	1.280,00	10,104
Gundremmingen C	RWE Power AG	BWR	Jan 85	1.288,00	8,621
Grohnde	E.ON Kernkraft GmbH	PWR	Feb 85	1.325,00	11,83
Philippsburg 2	EnBW AG	PWR	Apr 85	1.424,00	11,722
Brokdorf	E.ON Kernkraft	PWR	Dec 86	1.326,00	11,672
Mülheim-Kärlich	RWE Power AG	PWR	Oct 87	1.219,00	0
Emsland	RWE Power AG	PWR	Jun 88	1.290,00	11,450
Isar 2	E.ON Kernkraft GmbH	PWR	Jul 88	1.365,00	12,268
Neckarwestheim 2	Gemeinschaftkernkraftwerk Neckar	PWR	Apr 89	1.269,00	11,202
Total				22.284,00	169,874