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decision-making:
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**Concerned Public and the Paralysis of Decision
Making. Nuclear Waste Management Policy in Germany**

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Abstract

Efforts to site a high level nuclear waste repository in Germany date back to the 1960s. Ten years later the site Gorleben was officially selected and designated as a host for nuclear waste. However, public opposition and maneuvering by the major political actors prevented the completion of the site selection process, resulting in decades of political paralysis. The main reasons for this failure were the polarization in advocates and opponents of nuclear energy, the neglect for due process and participatory procedures, the inability to integrate technical, political and social rationales in designing a viable nuclear waste policy, and the confusing mix of responsibilities between and among political actors. In spite of the apparent failure to find a solution for high level waste, the German government succeeded in designating a site for radioactive waste with negligible heat generation (Konrad mine). It is assumed that further progress in waste management can be accomplished only if more deliberative elements are introduced into the policy arena.

1. Introduction

Radioactive waste is produced by industry, research institutes and medical facilities, but especially by electric power industries which operate nuclear power plants. German regulations require that nuclear waste is first transported to interim storage facilities before it is finally stored in one or several permanent repositories. However, such a permanent repository for high level nuclear waste is not yet in sight. The aim of a permanent repository is to isolate the nuclear waste, especially high level waste, for extremely long periods of time from the biosphere and to assure integrity of this repository to the point in time when the reduced radioactivity will be close to the natural background radiation. Depending on the composition of waste, this may last between several thousand and 100,000 years. Due to this long time intervals and the stigma of nuclear waste in public perception, designing and locating one or more permanent repositories have been confronted with fierce public opposition and protest. In addition, the political debate about the future of nuclear energy has led to a paralysis in decision making as the different political actors are locked into their own firm positions that do not lend themselves to compromise, let alone consensus on how to handle nuclear waste in the future. The search for a final repository for high level nuclear waste has turned into a nightmare for political authorities, regulatory agencies and the involved representatives of industry and civil society. Until today, this search has not led to the resolution of conflict in spite of major efforts to reach an agreement among the major actors.

The final disposal of nuclear waste is a topic that is still mobilizing public opposition and protest although newer 'issues' such as genetically modified food and nanotechnology have become more salient issues during the last decade. Public attention on nuclear waste has calmed down in recent years but this is mainly due to the fact that the siting process has come to a stalemate. However, each time a major transport of nuclear waste is conducted through Germany, one can be certain that such an event is accompanied by strong public demonstrations, often mixed with disruptive and sometimes violent forms of protest. Several environmental NGOs are active in fuelling this protest and do everything to keep the issue of nuclear waste on the public agenda. The various expert communities, the political parties as well as the NGOs are also far from reaching a consensus in this matter. This high level of attentiveness on the sides of the proponents and opponents of nuclear energy has not lost its energy in spite of the political decision to phase out all nuclear power plants in Germany.

In Germany, there are at present 17 operating light water reactors with an installed gross capacity of 21,457 MW. Six of the 17 reactors are boiling-water reactors, the others are pressurised-water reactors. Their share of the base load of power supply in Germany is calculated with around 50 percent, their share of total electricity production amounts to about 27 percent (2006).¹ 15 of the 17 reactors are part of the electricity generation capacity of the four major national utilities: E.ON, RWE, EnBW, and Vattenfall.² These reactors cluster in two geographical regions: in the southern states of Baden-Württemberg, Bavaria and Hessen on the one side and in the Northwest of Germany on the other.³

The concept of waste reprocessing was terminated by political decision in 2000, when the federal government and the energy suppliers reached an agreement to phase out all nuclear power plants until 2021.⁴ The phasing-out plan commits the utilities to phasing-out older plants

¹ http://www.thema-energie.de/article/show_article.cfm?id=4362 (access date: 26.02.08).

² The utility 'PreussenElektra AG' (as a subsidiary of the former VEBA AG) and the 'Bayernwerk AG' (of the former VIAG AG) were the origin of the E.ON AG with its division 'E.ON Kernkraft', which is the largest operating company of nuclear power plants in Germany. The RWE AG (up to 1990 Rheinisch-Westfälisches Elektrizitätswerk AG) is the largest German power supplier and EnBW ('Energie Baden-Württemberg') is the number 3 of the power suppliers. Vattenfall AB is the largest power supplier in the northern states of Europe and the 'Vattenfall Europe AG' manages their nuclear business in Germany.

³ For the general geographical distributions of nuclear power plants see http://www.kernenergie.de/r2/de/Gut_zu_wissen/KKW/Deutschland (access date: 23.12.08), more detailed and including the borders of the "Laender" see http://www.kernenergie.de/r2/documentpool/de/Gut_zu_wissen/Materialien/Downloads/055standortkarte2008_05.pdf (access date: 23.12.08).

⁴ 'Vereinbarung zwischen der Bundesregierung und den Energieversorgungsunternehmen vom 14. Juni 2000'.

earlier and newer plants closer to the final deadline. However, the utilities are flexible to some degree in deciding in which order power plants are shut down. Until now (2008), two reactors have ceased operation.

The phase-out has not had major institutional ramifications with respect to nuclear waste management. Under the revised Atomic Act the Federal Office for Radiation Protection is responsible for nuclear waste disposal as before when it was still named 'Physikalisch-Technische Bundesanstalt' (Federal Institute for Physical Technology).⁵ The recent granting of a license for the operation of the Konrad mine in Lower Saxony, i.e. the intended national final repository for low and medium level waste (with only negligible heat generation), issued by the Federal Office for Radiation Protection has been a step forward in dealing with nuclear waste. Yet this partial success should not be overestimated, as the radiotoxicity is very limited in comparison to high level and other heat generating nuclear waste. Siting a permanent repository for high level waste would necessitate the construction of a new site with new facilities even if the location that is under discussion now (Gorleben) were to be identified as a suitable location for many decades and already hosts an interim storage facility. So it is still an open question whether the responsible authorities, political leaders and their parties will find a commonly accepted solution for handling nuclear waste in Germany.⁶

This paper describes the history of the various attempts to resolve the conflict on siting a permanent nuclear waste repository and analyses the forces that have been essential in shaping this conflict. Section 2 provides an overview of the events leading to the present state of paralysis. Section 3 lists important factors that might explain the obvious failure of siting a German nuclear waste repository, section 4 provides a review of the present situation in its legal and political context, and section 5 gives an outlook to the future.

The conceptual framing of our analysis is two-folded. On one hand we investigate the role and performance of the central actors in the field of nuclear waste management policy and their failing attempts to organize a consensual solution for the disposal of the German high level nuclear waste. This investigation is inspired by collective action research and network theory (Wasserman and Faust 1994; Östrom 2000). On the other hand, the preparation of decision making in this case of high level nuclear waste is interpreted from functionalist (social actor) perspective where the four main actors of society: governments (including agencies and licensing authorities), industry, science and civil society interact and try to dominate the discourse based on the ability to influence the decision making process and to mobilize public support (original Parsons and Shils 1951; Jaeger et al. 2001, 175ff.; Renn 2008, 130ff; for nuclear energy: Kitschelt 1980, Hocke 2006, 161-165).

2. A chronology of nuclear waste management in Germany

To better understand the German problems in the search for a final repository for high level nuclear waste this section provides a brief history of nuclear waste management in Germany. Up to now, four disposal sites on German territory are in discussion: the experimental disposal site 'Asse 2', the Morsleben repository, the Konrad mine and the originally selected site for a permanent high level waste repository: Gorleben.

Early in the history (1960s and early 1970s), the public authorities in conjunction with the nuclear community and the electricity generating companies decided that rock salt in salt domes would be the best option (Tiggemann 2006, 87). In 1973, the siting process for a so-called nuclear waste management center (Nukleares Entsorgungszentrum, NEZ) became the central activity of the Federal Government to site a repository for high level waste. The idea at the time

⁵ Paragraph 9, passage 3, and paragraph 23, passage 1, of the Atomic Act say that the federal level is responsible for installing nuclear repositories and that this task is transferred to the Federal Office for Radiation Protection (Bundesamt für Strahlenschutz – BfS).

⁶ In addition to the international differentiation between high, medium and low level waste, the German authorities and regulations base their policies on the differentiation between 'waste with negligible heat generation' and 'heat generating waste'. The argument of the authorities is that the heat generating waste includes around 98 percent of the radioactivity of all nuclear wastes (see AkEnd 2002, 14-15; BfS 2007, 1; Rübel, Müller-Lyda, and Storck 2004).

was to establish a 'closed management cycle' by designing an integrated facility comprising an industrial reprocessing plant, storage facilities necessary for solid waste management, and an underground repository for all types of nuclear waste from Germany. It was envisioned to have the center located on one site. Experiences with salt as host formation were made in the German underground laboratory of Asse, which was established as a test site in 1965. This site located in the state of Lower Saxony hosted 124,000 m³ low level waste and 1,300 containers with intermediate level waste during its operation until 1978. The filling of the mine with salt to close instable parts started in 1980.⁷ As the results from Asse were regarded as promising in terms of the suitability of salt formations as host rock for nuclear waste, the search concentrated on locations above massive salt formations. Because salt domes and similar salt structures are predominantly found in the northern German lowlands and its border regions, the state of Lower Saxony became the main target area for siting the nuclear waste management center (Appel 2006, 57).

The site selection process for the German waste management center started in 1972 under the federal coalition government of Social Democrats (SPD) and Liberals (FDP). In the report on the siting process of February 1975, three salt domes in Lower Saxony were identified and ranked high on a list of potential candidates (Börger with the salt dome Wahn, Faßberg with the salt dome Lutterloh, Ahlden with the salt dome Lichtenhorst). In the aftermath, surface-bound investigations especially at the salt dome near Börger were initiated. As D. Appel reports, the final selection of the NEZ site was intended to be based on a comparative review of these three selected sites (Appel 2006, 58). The start of the investigation immediately caused strong local opposition; the inhabitants of these regions and particularly the landowners were outraged. They also complained that they had not been properly informed about the purpose of these investigations. As a result of their protest, the investigations were stopped in 1976.

Three months later the state government of Lower Saxony (formed by the conservative Christian Democratic Party, CDU) asked the federal government to stall the ongoing site investigation until the state government had designated a site of its own (Tiggemann 2004, 387; Appel 2006, 58). Differences between the federal and the state government aggravated the conflict (Rucht 1980, 72–3; Tiggemann 2006, 95). In February 1977, the Prime Minister of Lower Saxony, Ernst Albrecht, designated the Gorleben salt dome as the most suitable potential NEZ site. This judgment came more or less out of the blue. The federal government had included Gorleben in their initial list of potentially eligible sites, but it did not rank at the top of the list. Furthermore, there had been no testing or surface investigation at the site when the state government nominated it (Appel 2006, 59).

The comparative review of possible sites was abandoned in favor of selecting one site without further consideration of alternative options. A similar process took place in the United States, where a group of well-known decision experts started to rank several alternatives for siting a high level nuclear repository, resulting in a priority list of sites, which was basically ignored by the responsible authorities (US Department of Energy 1986; Keeney 1987). Until today it is not quite clear why the state government made a plea for the Gorleben site. Appel argues that the reasons of the State were never made public but he doubts that there were strong rational reasons (Appel 2006, 59): Anselm Tiggemann, a German technical historian, who wrote a detailed study about the selection process of disposal sites in Germany from 1955 to 1985, points out that the reasons were probably more political and strategic rather than technical given a strong pro-nuclear attitude by all parties in Germany at the time (Tiggemann 2006, 2004). However, the state government did use, according to his account, technical and safety arguments for selecting the Gorleben site.⁸ One should consider, however, that the plan

⁷ BfS 2005, 2. – Actually there is a number of severe problems with this former salt mine, as for years considerable volumes of water were running into the mine and the federal government decided to shift responsibility from one institution to another since the former responsible institution lost its reputation when details from handling these problems became obvious during 2008 (Krone 2008, Zeit Online 2008, BMU 2008)..

⁸ This approval of the decision of Prime Minister Albrecht and his state government by the federal level was steered by the application of four rather superficial criteria of safety with respect to final disposal: (1) no former mining activity in the salt dome, (2) sufficient size of the salt dome, (3) surface of the salt

to build an integrated waste management plant with reprocessing plants and conditioning facilities directed the attention of the professionals more to the surface activities and their potential risks to public health and the environment than to the risks of the final storage facility. The emissions from an above ground installation were regarded as the main reason for safety concerns (see Appel 2006, 58).

The federal government accepted this offer immediately as it promised to have outrage and protest concentrated in one area only rather than at many locations simultaneously. In addition, the proposal came from the opposition party thus taking heat away from the federal coalition government. However, this strategy did not work. Ignoring the results of the comparative review and choosing a site without major ground investigations fuelled immediate opposition and outrage by the population in and around Gorleben. In addition, the 1970s witnessed the rise of a strong and powerful national opposition against nuclear energy in general and the obvious flaws in selecting the disposal site were a welcomed opportunity for the national nuclear opposition to choose Gorleben as a central location for national campaigning and demonstrations. As the protest was successful in getting media attention and the pressure on established political actors increased over time, the state government became more and more defensive in their argumentation. The turning point was the decision to conduct an international hearing on Gorleben, including the issue of reprocessing and final storage (March/April 1979). Prominent scientists and technology specialists were invited to the hearing to assess the technical feasibility of the whole concept, to comment on safety concerns and to evaluate the integrated waste management design. The hearing demonstrated that even the proponents of nuclear energy had some doubts about the feasibility of the integrated design. A few weeks after the hearing, in May 1979, the Prime Minister Albrecht of Lower Saxony Albrecht concluded that the technical feasibility of a reprocessing plant in Gorleben had found sufficient support from the members of the hearing, but that such a plant would not be politically feasible. Therefore, the State would not follow the original plan of pursuing an integrated design including reprocessing, waste conditioning and final disposal. He emphasized, however, that the site was still suitable for hosting a high level nuclear repository. The concept of an integrated nuclear waste management center was abandoned after the hearing and replaced by the plan to use the site for a final repository with attached interim storage and conditioning facilities.

After this decision, the site was thoroughly investigated. The main phase of above ground investigations lasted from 1979 until 1983. The tests were accompanied by fierce public opposition and protest and, in response to this protest, by state and federal efforts to conduct public meetings, offer technical expertise to the local population, and provide information about the siting process. There were no attempts, however, to initiate any formal participation of the public in this process except for giving local residents the possibility to voice their opinions in public hearings. In the beginning of the investigations, public authorities also provided information platforms and panel discussions that included nuclear critics (Appel 2006, 60). However, after the federal government changed from a social-liberal coalition to a Christian-liberal majority at the end of 1982, the now aligned state and federal governments were keen on presenting their case in the most positive way and excluded more critical voices from the official agenda.

In May 1983, the responsible federal authority Federal Institute for Physical Technology presented a report on the results of the Gorleben surface investigations, which came to a positive conclusion about the suitability of the site for hosting high level nuclear waste. In this report, they introduced the term 'Eignungshöflichkeit' (high likelihood of suitability), which became the central term in the ongoing discussion of the site selection, and addressed the safety relevance of the geology of the Gorleben site based on studies about the performance of an existing geological channel in the overlying rock of the salt dome. However, the report became a highly disputed issue. Both, the concept of "Eignungshöflichkeit" and the relevance of the studies about the Gorleben channel received harsh criticism by a group of mainly anti-nuclear experts and activists. The results of this report were discussed during a meeting in Hitzacker (May 1983) – no critical experts were invited; only representatives and speakers from

body less than 400 meters below surface, but not extending too far into near-surface groundwater, (4) no usable resources (Appel 2006, 59).

the institutions responsible for final disposal or involved in the concrete investigations presented the procedures and the results of the investigations. Due to this positive preliminary test results, the federal government gave the permission for below ground investigations in mid-1983. In 1984, a shaft was installed and interim storage facilities were also constructed on the surface.

The next 12 years were characterized by an intermezzo of investigations, court orders to stop any construction work and higher court orders allowing further construction activities. Ruetter & Partner (2005, 113) have characterized the period until 1996 as 'stop-and-go policy'.⁹ The period was marked by the mining process for investigation purposes ('Erkundungsbergwerk'), the construction of buildings for interim storage of waste, the transport of Castor containers (filled with waste from nuclear power stations) to the interim facility, the failure to build one central national waste conditioning facility, a multitude of law suits against the investigation and the construction of the interim storage facilities, which did not stop the investigation but delayed it considerably. Important actors in that time were the anti-nuclear activists, the companies responsible for building the disposal site, the political parties (in particular the Green Party as part of the anti-nuclear opposition and the conservative party as a proponent of nuclear power) and the environmental ministries on the federal and state level (Ruetter & Partner 2005, 133). In essence, the investigations took far longer than planned. The whole process could be described as a 'messy muddling through' void of any coherent action plan.

In this time period there was also the transition from a conservative state government to a government formed by the Social Democrats in 1990. Again federal and state governments were composed of different party coalitions leading to fractions between the two vertical governance levels. The conflict escalated in the middle of the 1990s when the anti-nuclear movement was surprisingly successful in mobilizing against the transport of the first spent fuel elements from nuclear power plants and later also from the French reprocessing plant Le Hague to Gorleben (Kolb 1997). After phases of latency in the years before the opponents organized impressing protest demonstrations and exercised civil disobedience around the transport routes.¹⁰ Continuous civil disobedience and sometimes riots with police guarding the transport brought the unsolved societal conflict about nuclear waste back onto the national agenda. The slow progress in testing and construction also reflected the growing discontent of the general public in Germany with nuclear energy and the slow change within the Social Democrat Party (SPD) from supporting to opposing the option of nuclear energy.

In the aftermath of the Chernobyl accident, the Social Democrats started to question their pro-nuclear position. Within a decade (from 1986 to 1996) the party reversed its position and, in the end, opted for phasing out nuclear energy. This position is still the official line of the SPD and reflects the opinion of the majority of party members and most fractions in the party, although prominent party members such as Wolfgang Clement have openly criticized this official policy in the media and other public forums.¹¹

Parallel to the stop-and-go policy at Gorleben a second site was discussed as being suitable for managing low and medium level nuclear waste. In 1982, the PTB applied for a license ('Planfeststellungsbeschluss') for a disposal site for nuclear waste with negligible heat generation in a former iron mine called Konrad mine. In the years 1992/93 a public hearing ('öffentlicher Erörterungstermin'), was organized to give residents the opportunity to voice their opinions. In spite of strong public opposition, the State of Lower Saxony approved the license for the Konrad mine as a final disposal site in 2002. However, the State restricted the maximum volume of waste to 300,000 cubic meters. The request by the operator for direct execution of the licence to start immediate operation was retracted and so opponents were allowed to file a lawsuit and a number of stakeholders did so.

⁹ A number of courts on the state and national level were involved and the literature gives only a vague description of this process.

¹⁰ For the anti-nuclear movements and their phases with successful campaigns and latency see Rucht 2007, esp. p. 257.

¹¹ For the struggles between these two dominating parties in the end of 1979 see Tiggemann 2004 and Popp 2006.

With the reunification of East and West Germany in 1989, the central disposal site of the former German Democratic Republic became a further candidate for handling nuclear waste. This site was located at Morsleben in Saxony-Anhalt. Between 1994 and 1998, waste from operating nuclear power plants (but not spent fuel) from all over Germany were stored at Morsleben until in September 1998 the Higher Administrative Court Magdeburg stopped the disposal activities. Together with the experimental repository Asse 2, Morsleben was placed in the category of being in the phase of decommissioning, allowing waste disposal only for a limited time period. At both sites, technical problems had occurred that did not allow a substantial prolongation of the license to store waste there (BfS 2003; Kautenburger 2008).

An attempt to revitalize the slow and indecisive site selection process and to react to the societal conflict in a more constructive way was made by the newly elected federal government of Social Democrats and the Green Party starting in 1998. The coalition parties of the red-green federal government had concluded at the end of the year 1998 that the basic elements of the previous waste management concept had failed (Committee 2001, 56). They intended to develop a new national waste management plan. Against the background that large parts of the German public were opposed to the three possible candidates for final disposal (Gorleben, Konrad and Morsleben) and inspired by the impression that the previous site selection processes were substantially flawed, the government created a new institution called AkEnd (*Arbeitskreis Auswahlverfahren Endlagersuche, Committee on a Site Selection Procedure for Repository Sites*). This group was asked to develop a proposal for a transparent, criteria-based and convincing approach for a comparative site selection process, which should also include effective forms of public participation (see Hocke-Bergler and Gloede 2006, 91). In parallel, the government decided to phase out nuclear energy, thus limiting the capacity of the repository to the volume of waste that was or would be produced until the last nuclear power plant were to be dismantled. Part of the new nuclear policy was the so-called 'Gorleben Moratorium': This moratorium started in October 2000 and included the provision that the exploration of the Gorleben site would be stopped for a minimum of three years but work could resume after 10 years if no agreement could be reached (Ruetter & Partner 2005, 113; Haury 2006, 65).

The AkEnd consisted of a multi-disciplinary high level expert group with different positions pro and con nuclear energy. In the beginning, they were successful in integrating the national and international stakeholders into the new effort for a comparative search for a German nuclear waste disposal site independent of any commitment to the host rock. In this context AkEnd was also successful in bringing important stakeholders from industry, public authorities and civil society organizations into the deliberations. As a result of their work from 1999 to 2002, the group developed a proposal for a comprehensive procedure to initiate a new comparative site selection process. In addition, the group generated a set of selection criteria leading to a stepwise approach in site selection and assuring transparency along the entire decision process (AkEnd 2002). The stepwise approach was supposed to start with a 'white map' of Germany with the identification of areas that would meet minimum requirements, which over many testing and evaluation steps would further filter the more suitable from the less suitable sites. In the end, a small number of top locations should be more thoroughly investigated. If this proposal is accepted, the advisory group recommended extended community involvement in decision making and a process of local democratic ratifications in a series of staged decisions.

The AkEnd suggested that the major political parties in Germany (CDU, CSU, SPD, FDP, and the Greens) should buy into this plan because such a process would not be successful without the approval of the main political actors. In addition, they recommended that the process should be accompanied by a Supervisory Board from an early step in the selection process.¹²

Unfortunately, the AkEnd group and its supporters were not successful in convincing the political key actors to follow their recommendations. Even the German Minister of the Environment, Jürgen Trittin, who had initiated the AkEnd process, was not willing or not in the position to support the recommendations of this committee. Spokespeople from the electric utilities also refused to take part in the suggested process; they insisted on Gorleben as a viable and well-developed solution and disagreed with the judgment of AkEnd and its supporters that a

¹² One problem in this context is, that the AkEnd proposal was not precise in identifying the groups of stakeholders, which have to be represented in the supervisory board (AkEnd 2002, 195, 197; Jentzsch 2003, 37, 58).

reformed comparative site selection process should be initiated as the best means to find a politically feasible solution to the nuclear waste crisis. In the end, the government failed to adopt and implement the suggestions (COWAM 2 2006, 39; Grunwald and Hocke 2006; Vorholz 2003). The international resonance on the AkEnd proposals was remarkable in terms of being often cited and classified as state of the art (for example in Switzerland), but no concrete steps were taken to implement any of the suggestions. Notwithstanding the good will and enthusiasm of the group, in the end the siting process in 2003 was exactly where it had been in the late 1970s.

However, unexpectedly there was some movement in recent history with respect to the disposal of low and medium level waste. As mentioned before, the decision to license the Konrad mine for nuclear waste with negligible heat generation had been challenged in court. The Lower Saxony Higher Administrative Court (Oberverwaltungsgericht), however, rejected a number of claims against the pending license of this disposal site and a revision of the court's decision was denied in March 2006. The plaintiffs turned to the Federal Court of Justice (Bundesverwaltungsgericht) with the request to overturn the state court's decision. But the federal court confirmed the decision of the state court in April 2007. The possibilities to take legal action against the license are thus exhausted and the waste disposal facility at Konrad has been granted a valid license. The Federal Office for Radiation Protection has announced to start in 2013 to store waste with negligible heat generation there. This operating plan for the installation of the disposal site was also accepted by the responsible Lower Saxony State Authority for Mining, Energy and Geology in January 2008. After 40 years of struggling, there seems to be a real chance that at least medium and low level waste will be stored in a designated repository in the near future.¹³ Such a solution, however, is not in sight for high level waste.

3. Reasons for the failure of siting a German nuclear waste repository

After reporting about the events that lead to the present situation, the question arises, what reasons or factors can be identified to explain the obvious failure of siting a high level nuclear waste repository in spite of major national efforts and investments. This section hence changes the perspective from the descriptive to the analytical mode. However, this analysis is not based on quantitative results of empirical research but constitutes reflections of the authors based on their interpretation of the historical development, the study of official documents, and personal interviews with key actors in the field.

3.1 *The impasse over nuclear energy*

Why has the AkEnd failed to overcome the political paralysis on nuclear waste disposal? First of all, Germany is faced with the same problems as most other countries that have problems in siting nuclear waste repositories. The world is strongly divided into proponents and opponents of nuclear energy. Almost all countries using nuclear energy face public opposition and political debate when it comes to nuclear waste management (Finland may be a notable exception). One can assume that the intensity and strength of opposing positions towards the use of nuclear energy has been the main reason why political decisions have been unable to make any progress in this question. Without any doubt the issue of how to handle nuclear waste has become one of the most forceful controversies among political parties, industry and civil society actors over the last 40 years (Kunreuther et al. 1990; Sjöberg 2004). The debate has centered on issues such as: What is the right point in time to have a final repository available? Which host rocks are suitable? What criteria should be used to select the site for the repository?¹⁴ In the course of this debate, most political actors, including the moderate environmental NGOs, were unable to resolve their conflicting views on these questions. From our perspective, this seems to be the case in many countries trying to find a solution especially for high level waste.

¹³ see <http://www.bfs.de/en/bfs/presse/pr08/pr0801.html> (access date: 22.01.08).

¹⁴ In this context, see also Grunwald and Hocke 2006, 14-15.

But in spite of all these differences and the complicated controversies between governmental organizations, stakeholders, protest groups, and the interested public in Germany, an agreement on four aspects has evolved over time:

- A permanent repository is necessary regardless whether nuclear power generation is continued in Germany.
- The decision on the location and the construction should not be delayed or postponed to the time when the interim storages need to be vacated.
- A national site is preferred over a pan-European or other international solution.
- The preferred method to dispose of high level nuclear waste is the storage in deep geological formations.

Beyond these general agreements, there is still an extremely controversial debate about the remaining issues such as the rock formation that promises to be most suitable to host nuclear waste. From the 1960s to the 1980s, experts on nuclear energy favored salt formations as final host for this waste. The main reasons for these preferences were the elasticity of salt to engulf nuclear waste containers and the absence of water in these formations for thousands of years. However, this early consensus on the rock formation was challenged after a site with a potentially suitable salt formation was identified (Gorleben). Those who opposed the site suggested other suitable rock formations and referred to search activities abroad where more solid formations were obviously taken into consideration or even preferred. As a result of this debate, not only salt formations were considered suitable but also host rock formations consisting of 'clay' and 'granite', both available in Germany. Granite is preferred in Sweden and clay in Switzerland.

When reviewing the scientific debate about nuclear waste management, it seems to be an outstanding question whether ethical arguments were or are part of the official policy and the debate about it. Ethical arguments tend to pop up in the German discourse on nuclear waste politics (e.g. German nuclear waste must not be exported; we should not leave a legacy of unresolved problems to the next generations). However, such ethical arguments may have motivated many opponents of nuclear energy to enter the debate, but surprisingly they have not shaped the content of the controversies or become major conflicting points in the official debate. Only protest organizations stress the violations of equity with respect to the distribution of benefits and costs in this context, but governmental organizations, industry and political parties continue to neglect this issue. In our interpretation, the conflict was fuelled by the struggle in terms of power, institutional competence, and due process, which was the most controversial in the risk discourse and formed the articulated concerns of the interested public.

3.2 The perceived violation of procedural equity

The main controversy with respect to locating a waste disposal site is, however, not the decision on the most suitable rock formation or on the engineering details of the needed facilities to isolate waste for many centuries but the process of decision making itself. The key term here is the perceived violation of procedural equity, i.e. the impression of the stakeholders and the general public that the process is neither transparent nor democratic (Okrent 1988; Renn, Webler, and Wiedemann 1995). (Post-)modern societies in general face severe problems of legitimizing collectively binding decisions (Luhmann 1990). Knowledge claims by expert communities as well as value claims by stakeholders tend to become more plural, leaving little room for integration. As a result of the pluralisation of knowledge, procedural legitimisation becomes more and more important. Public outrage is therefore not only associated with the subject (nuclear waste), but also with the governance of the policy process (Linnerooth-Bayer and Fitzgerald 1996). The main question here is: What kind of procedures to handle conflicting knowledge claims, diverse interests, and plural values are compatible with the dominating image of democratic decision making?

As explained in the section on the history of nuclear waste management in Germany, the aspect of due process and transparent procedures was highly neglected during the first three decades of searching for and investigating a potential site. The later discussions in the 1990s explicitly addressed this problem and provided three responses to this question:

- a.) the *legalistic solution*, claiming that the decision making process should meet the normal standards and regular procedures of representative government. Any involvement of civil society actors should be confined to consultation processes without any obligation of the legal decision makers to include the results of the consultations into their own policies (this position was implicitly the dominant position of the period between 1960 and 1980);
- b.) the *'muddling through' strategy* of decision making (Lindbloom 1959) aimed at achieving a minimal consensus that can be accomplished by avoiding major conflicts and pursuing policies that tend to focus on postponing controversial decisions (this position was implicitly the dominant position of the period between 1980 and 2000);
- c.) the *model of deliberative democracy* by which stakeholders are invited to be directly involved in the policy process (Renn 2004). Many advocates of such a model favor the ideal of a Habermasian discourse based on the competition of arguments and a joint agreement on common values (this position was the inspiration for the AkEnd committee starting its work at the end of the 1990s).

One of the major problems in the German debate on nuclear waste management is that until today there is no agreement among the main actors (and even within each actor group) on which of the three approaches should be further pursued. The formal and informal governance procedures oscillate between deliberative inclusion and legalistic closure with muddling through phases in between. This introduces an erratic element in the history of the German effort to come up with a national policy on waste management.

3.3 The disjunction between the technical, political and procedural discourse

The failure of the German government to site a nuclear waste management facility can also be attributed to the failure to differentiate between three different types of discourses. These discourses are all necessary to deal with the issue of nuclear waste management: first, a discourse among experts on the risks and benefits of different disposal options and repository locations; second, a political discourse on the future fate of nuclear energy; and third, a procedural discourse on the most appropriate decision making process (Barke and Jenking-Smith 1993).

Until the mid-1970s, the debate on nuclear waste in Germany was dominated by the first discourse while the political debate was preoccupied with the question of nuclear power generation. The third discourse on procedures was limited to finding effective strategies to cope with the new environmental and anti-nuclear movements. Starting with the late 1970s, the debate moved to the political discourse ending in the decision by the State of Lower Saxony that in spite of the technical feasibility a repository was not politically possible given the degree of public opposition (see above). Starting with the 1980s and lasting until the late 1990s, the decision on nuclear waste management was put on the back burner, concentrating more on expert discourses on technical improvements of the needed facilities and geologic testing of the Gorleben site. During this time period, little attention was paid by the interested public, but also by the involved governmental organizations, the nuclear industry and others. There was an implicit moratorium on nuclear energy expansion, and the waste issue seemed to be out of reach as interim storage was assumed to capture at least a time span of 30 to 70 years. So one could lean back and leave it up to the experts to test the proposed site(s) and to the local and national opposition to make sure that the process was slow enough to prevent any real progress. Anybody seemed to benefit from paralysis.

Starting with the late 1990s, the third discourse on procedures became the dominant topic of discussion. The AkEnd group was convinced that without due process and transparent procedures all efforts to make any progress in this debate were deemed futile. However, the lack of political discourse in parallel to the procedural discourse prevented a breakthrough on the political level. In addition, the technical experts frustrated by decades of debate showed little motivation to engage in another comparative review of suitable sites and opted for a wait-and-see attitude. Germany was not able to find a setting for conducting these three discourses in parallel and interconnected.

The failure to distinguish between the three types of discourse and the oscillation between the three is closely related to the procedural equity question that was raised in section 3.2. As there was no clear vision, let alone a protocol or plan of how to design a scientifically sound and

democratically legitimate procedure for combining expertise, political decision making and public preferences, the actual process meandered between the various extremes of technocratic, decisionistic and deliberative modes of policy making and implementation (Renn 2001). This inability to develop an integrated approach to link the three discourses without ignoring their analytic differences was a major flaw of the process and contributed to the paralysis that persists until today.

One of the reasons for the lack of coordination among the three discourses is the lack of problem-oriented interdisciplinary research on the subject that integrates the analysis of the social process behind the conflict into a comprehensive research design (see Bella, Mosher, and Calvo 1988). There are many studies on the technical and safety aspects of a repository, there is a limited amount of studies on the political decision making structure and the reasons for the present state of paralysis, and there are well-meant suggestions of how to incorporate more deliberative elements in the decision making process.¹⁵ But there is hardly any attempt to link the issues of technical suitability, safety analysis, political feasibility and social compatibility with public preferences and democratic goals.

German policy analyst Peter Wagner addressed this issue and, following his arguments, a couple of transdisciplinary research questions can be articulated (Wagner 1994). The first question is, whether the strong link between nuclear power and waste disposal could be overcome by limiting the capacity of the repository to host only the existing amount of waste. The second question links the stability of anti-nuclear attitudes to special political movements that have renewed themselves over a long period of time without falling prey to the issue-attention cycle. Wagner hence raises the question whether this stability is a function of missing democratic governance structures (which could be changed) or of a more fundamental disliking of nuclear energy beyond any procedural issue (Wagner 1994, 287, *passim*). This proposition is supported by the fact that the political shift against nuclear energy started as early as 1986 in the aftermath of the Chernobyl accident, when the Social Democrats changed their pro-nuclear position and the public opinion in Germany became very critical against nuclear energy. This sceptical position remained dominant in German politics and cumulated in the governmental decision to phase out all 17 nuclear power plants until 2021 (Rüdig 2000). However, with the new discourse on climate change and the transition to a low-carbon society, the debate on nuclear energy has re-emerged and the phase-out has come under attack by conservative and some environmentalists' stakeholders. No one can be sure whether the phasing out will be permanent in Germany's energy policy or only a short interruption.¹⁶

3.4 Confusing mix of responsibilities

The three factors that we have identified to be major causes of the present problems in nuclear waste management have certainly been aggravated by the mix of responsibilities between the state and federal level of government. Due to the federal political and administrative organization of Germany, the distribution of tasks and responsibilities within the sector of radioactive waste disposal differs from the structure in most other countries. The federal government, and in particular the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, serves as the central regulator and supervisory authority. For three of the four disposal projects (Gorleben, Konrad mine, and Asse 2) the state government of Lower

¹⁵ Important studies on nuclear politics and protest are Rüdig 2000, Rucht 1995 and 1994 (especially pp. 443-5), and Kolb 2007; for ethics see Boetsch 2003, and for media reporting on nuclear waste transports to Gorleben which are cited under the name of the containers called 'Castor' see Berens 2001 and Schulz, Berens, and Zeh 1998. Reflection on the AkEnd process is available at Niedersächsisches Umweltministerium 2003, ILK 2003, Hocke-Bergler and Gloede 2006, Hocke-Bergler, Stolle, and Gloede 2003. In the last ten years, some collections of essays were published which should show different positions in the waste debate (Lux 2003; Grawe and Picaper 2000; Busch and Paretzke 1999; IPPNW 1995); conflict management and deliberative politics are the frame for some anthologies or conference reports like Dally 2003a, Dally 2003b, COWAM 2 2006 and 2007; in consultative perspective the work of Ruetter & Partner (2005) and Barth et al. (2007) is important.

¹⁶ In this context, see Roose 2009 (forthcoming).

Saxony and for the forth site (Morsleben) the state government of Saxony-Anhalt act as licensing authorities on behalf of the federal government.

The energy suppliers are responsible for the interim storage of spent fuel at some of these selected sites, for financing of the final disposal, and the R&D of suitable procedures to handle nuclear waste and spent nuclear fuel (Appel 2006, 56–57; Bröskamp, Brammer, and Graf 2004).¹⁷ The applicant and operator of nuclear waste repositories is the Federal Office for Radiation Protection. According to the German Atomic Energy Act, the construction, operation and closure of a repository must be licensed within the scope of a complicated permitting (i.e., licensing) procedure. This procedure includes, inter alia, an environmental impact assessment and the involvement of the public via a public hearing (BfS 2007). The permitting process also includes zoning permits issued by the local communities. The Federal Office for Radiation Protection commissioned the German Company for the Construction and Operation of Waste Repositories (Deutsche Gesellschaft zum Bau und Betrieb von Endlagern, DBE) to attend to the Gorleben site, the Konrad mine, and the repository Morsleben.

There is hardly anyone who understands the complicated web of responsibilities and duties. A redistribution of responsibilities was discussed during the last years. The aim was to state clear responsibilities for the industrial waste producers and remove the double role of the Federal Office for Radiation Protection, which is responsible or strongly involved in the construction and (future) operation of final waste disposals, but also responsible for judging the suitability of sites and other related issues. The goal of the proposed reform was twofold: making the process simpler and separating operation from control and oversight. Unfortunately, the proposed reform was not accepted by the federal or state governments. The mix of responsibilities prevails until this day.

4. The situation in 2008

The present situation can be characterized by four parallel processes:

- an ongoing paralysis of decision making among and between the responsible and involved actors,
- the unresolved political struggle between the two large political blocks about the future of nuclear energy (phase-out or re-birth as a solution for climate change),
- the existence of a powerful protest movement by civil society actors who are able to mobilize large sections of the population against the Gorleben site,
- pressure by small groups to initiate a new integrative approach to siting based on the recommendations of the AkEnd group. It is unclear at the end of 2008 whether these groups will gain the necessary influence on the official process of decision making in order to change the political situation towards a more deliberative approach.

The German political system missed an opportunity when it failed to act upon the recommendations of the AkEnd group. The German Bundestag had worked on a draft for a new law for the standardization of selection procedures for nuclear waste disposals in Germany based on these recommendations, but did not reach a conclusion in this matter. It is an open question whether the Social Democrats under Chancellor Gerhard Schröder and his Minister of Economic Affairs (both Social Democrats) were not willing to accept the draft or whether the

¹⁷ Part of the German controversy on nuclear waste is related to the question whether the energy suppliers are allowed to externalize a certain amount of costs in the field of disposal. In the present waste management concept, the suppliers are committed to pay, but the government is responsible for the repository site selection and installation. In this context, the 'formal' research repository Asse, where a remarkable amount of waste has been buried, is financed by public money and in the Gorleben case, it is controversial whether, in reaction to the concerns about suitability, a comparative site selection process as proposed by the AkEnd can be financed by the suppliers or should be paid by public money. The utilities argue in this case that such a comparative review is not necessary for technical but only for political reasons and hence it would be the task of the public authorities to pay for such an 'unnecessary detour'.

Minister of the Environment, Jürgen Trittin (the Greens), was not convinced from the AkEnd approach and decided not to fight for it. Nevertheless, there may still be an opportunity for revival as the German Bundestag never voted on the initiative (Ruetter & Partner 2005, 114).

After the coalition of the Social Democrats and the Green Party was displaced by a new coalition between the conservative Christian Democrats (CDU) and the Social Democrats (SPD) in 2005, the old schism between supporters and opponents of nuclear energy has dominated the political debate within the coalition. The decision to phase-out nuclear energy has not been touched and remains in effect, but the conservative party has declared in public that they would change the phase-out law if they gained a majority vote together with the Liberal Party in the next legislation starting in the end of 2009.

The Social-Democratic Minister for the Environment, Nature Conservation and Nuclear Safety, Sigmar Gabriel, emphasized in several speeches that he and his responsible ministry were not fixed on the Gorleben site. But up to now he has not been successful in getting a stable majority within the federal government to favor an open comparison between different sites and possibly between different host rocks, unless there is a clear consensus among the technical experts that these alternative sites are at least as good as the one in Gorleben (BMU 2006).¹⁸ The representatives of the conservative party attack this view by assuming that such a link between professional judgment and site suitability is nothing but an excuse to postpone the decision to a far future (when he is no longer in office) (see e.g. Mohr 2006).

The recommendations of the AkEnd group, including the provision for a Gorleben moratorium, have the potential to guide a joint effort by governmental organizations, energy suppliers and NGOs to find a constructive way of conflict management, but in 2008, the year this article was written, the proposal is 'dead': One side opposes the recommendations as an 'irrational' and 'ideological' crusade against nuclear power, and the other side seems to gain political benefit by postponing necessary decisions.¹⁹ Unless the government places this issue on the top list of priorities, it is likely that the paralysis will prevail for another decade or more.

5. Conclusions and outlook

This article describes the history of siting one or more repositories for nuclear waste in Germany and analyzes the reasons why this process has failed with respect to high level radioactive waste. The main reasons for the obvious failure of the site selection process are identified as:

- the polarization between proponents and opponents of nuclear energy, using the issue of waste management as the most strategically important battleground to push their perspectives;
- the neglect of democratic procedures and public involvement, leading to a general discontent with the siting process and a strong incentive for public mobilization;
- the inability of the parties to link the technical, political and procedural issues into an integrated approach;
- the confusing mix of responsibilities and duties that impede any effective decision making process and lead to political paralysis;
- the ongoing struggle about the adequate path for the future energy mix ranging between fossil fuels, nuclear energy and renewable energies. If nuclear energy is not phased-out by 2021, which many stakeholders and the conservative party demand, the amount of waste to be managed and deposited will increase. This will have severe repercussions on the position and strategy of the anti-nuclear activists and other civil society actors.

¹⁸ One conflict in this context was whether the Gorleben site should be part of the comparison. In October 2008 Minister Gabriel argued that Gorleben should be compared with other German sites and so it would be part of any reformed selection procedure (http://www.bmu.de/reden/bundesumweltminister_sigmar_gabriel/doc/42508.php, access date: 19.12.08)

¹⁹ In this context, see for example the comments of ILK 2003, Pescatore 2006, 97-98, and in the actual context BMU 2006 and ILK 2007.

There was a gleam of hope when the federal government initiated the AkEnd group in 1998. This group of experts and representatives of stakeholders recommended in 2002 to start the process all over again and engage in a comparative stepwise review of eligible sites. This suggestion was deliberated in the German parliament but not further pursued. At this point in time, the siting process for high level waste is still up in the air. A solution is not in sight.

Selecting a site for low level and medium level radioactive waste proved to be less aggravating. In 2007, the Konrad site was approved by the courts and can start operation in 2013. One should be aware that this repository is mainly responsible for taking up hospital and research-related waste, as well as waste from the decommissioning of nuclear power plants, but no spent fuel. All these waste items are not under dispute and more or less independent of the decision about the future of nuclear energy in Germany. The hope that the decision to phase out nuclear energy in Germany until the year 2021 would facilitate the agreement on how to treat high level waste (which includes spent nuclear fuel) proved to be premature as the recent concern about climate change has brought the option of nuclear energy for CO₂ reduction back into the political debate.

The compromise to limit the capacity of a radioactive waste repository to a volume that fits only the amount of waste accumulated until the end of the nuclear power phase-out has been proposed in the AkEnd discussion but was also not pursued any further. Given the present debate on extending the time period before the phase-out of nuclear power plants will take place, this compromise is also under severe attack by more conservative political parties. The problem that the extension of nuclear operation for another 20 years would significantly increase the amount of nuclear waste is hardly discussed by the parties and stakeholders.

There are, however, initiatives among several stakeholder groups to push for the recommendations of the AkEnd group. The experience that a number of countries like Sweden or Finland have been successful in site selection by comparing different sites and having the affected public involved in the process have encouraged some stakeholder groups to propose similar processes for Germany (BUND 2007).

The experiences in Finland, Sweden and lately Switzerland have demonstrated that progress can only be made when a deliberative concept of site selection, site testing and site operation is pursued (Lidskog and Litmanem 1997).²⁰ Having such a process does not mean that the problem can be resolved, but without such a process the international evidence suggests that paralysis and stalemate will prevail. At this point in time, the German political actors are still reluctant to engage in such a deliberative process that would include a new openness towards other eligible sites, a transparent process of decision making and an adequate platform for stakeholder involvement and public participation (Renn 2004). From the perspective of the concerned public, our impression is that the affected population expects to be integrated in a deliberative oriented process with substantial participation. This would imply a substantial shift in the forms of representative democracy and the corresponding forms of decision making (Kraft 1988). It is unclear whether the political-administrative agencies and the political parties would support such an open form of participation. It is also not to be expected that the energy industry with its economic interests would be in favor of empowering residents to become decision makers in this matter. After all, they invested almost 1,5 billion Euros in the Gorleben site and believe that this site is good enough for hosting high level nuclear waste. So there may be good reasons for continuing the muddling through approach, yet it will most likely not resolve the issue.

The open research questions with respect to the German nuclear waste management program are related to the conditions and potential catalysts that could facilitate or broker a common understanding between the technical, political and social communities involved in the present debate. At some point in time the nuclear waste that is already produced must be stored somewhere. Acknowledging this necessity is the first step towards finding a suitable solution. In addition, actors need to recognize that only a joint effort can lead to a breakthrough in this question. Lastly, it must be clear that without a national consensus on the future of

²⁰ Also the latest concept discussed for Great Britain emphasises the substantial participation, voluntarism and partnership (CoRWM 2006).

nuclear energy in Germany the problem of waste disposal will always be used as a dead pledge against any proposal to resolve the nuclear waste issue.

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Table 1: Timeline in major shifts and turning points in German HLW management

| Year | Event |
|----------------------|--|
| 1960s to early 1970s | Selection of host rock (salt domes) and development of a waste management strategy (NEZ) |
| 1973 | Start of the siting process (NEZ) |
| 2/1977 | Lower Saxony presents Gorleben salt dome |
| 7/1977 | Federal government accepts Gorleben |
| 11/1977 | Gorleben at least suitable for low and intermediate level waste |
| 3–4/1979 | Gorleben Hearing |
| 4/1979 | Start of Gorleben investigation |
| 1985 | Start of shaft sinking at Gorleben |
| 1996 | Start of underground investigation at Gorleben |
| 2000 | Gorleben Moratorium and renewal of the Atomic Energy Act |
| 2002 | Expert group 'AkEnd' published recommendations for a national comparative stepwise site selection process and updated transparent criteria for the selection |
| 2005 | Transformation ban ('Veränderungssperre') for the Gorleben salt dome |

Sources: own compilation (based on Appel 2006, BfS 2007, and Ruetter & Partner 2005)