Technical safety vs. public involvement? A case study on the unrealized project for the disposal of nuclear waste at Wellenberg (Switzerland)

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Technical safety vs. public involvement? A case study on the unrealized project for the disposal of nuclear waste at Wellenberg (Switzerland)

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The disposal of radioactive waste is a striking example with which to trace the changing relationship between technology, society and policy when dealing with societally relevant controversial issues. The change is characterized by a transition from a technocratic approach to an approach with more intense cooperation and public participation. We analyze the societal discourse of a failed disposal project for low- and intermediate-level waste at the Mount Wellenberg site, Canton of Nidwalden (Central Switzerland). Insights are based on a case study in 2006, with focus groups, expert interviews, a media analysis, a representative canton-wide postal survey and targeted in-depth stakeholder interviews. The article focuses on the relationship of safety and process aspects. The data suggest that both are prime issues and people recognize the need for disposal of radioactive waste in a technical system but only if a fair procedure is guaranteed. We conclude that a sound balance between safety and procedural aspects needs to be found and thus a functional-dynamic view of public involvement is necessary, i.e. distinct levels of involvement (ranging from mere information up to empowerment) must fit the corresponding technical and non-technical requirements of a stepwise decision-making process.

Keywords: nuclear waste repository; safety; public involvement; fairness

1. Introduction

Radioactive waste has to be disposed of safely and kept clear of the biosphere over a long period, due to its hazard potential extending to hundreds of years for low-level waste and hundreds of thousands of years for high-level waste and spent fuel. The disposal is considered best by the technical community in appropriate geological formations (e.g. clay rock) using engineered barriers (e.g. steel canisters) to provide long-term isolation. In recent years, public involvement and process aspects have become of paramount importance (e.g. CoRWM 2006), as traditional technocratic “decide-announce-defend” strategies (Blowers et al. 1991; Kemp 1992) have proved unsuccessful while the radioactive waste community has started recognizing societal needs and the integration of societal inputs (NEA 1999). They acknowledge that the long-term safety “proof” of waste disposal facilities is far more encompassing and
complex than civil engineering and geosciences, and that (technical) safety requirements and the societal need for appropriate involvement in the decision-making process have to be matched.

Following this, processes have come to include non-technical dimensions in “bringing geology and society together” (Lidskog and Sundqvist 2004, p. 263). For geological, technical and managerial reasons which call for a “one repository solution”, distributional fairness cannot be achieved: society’s benefits from nuclear energy (electricity production) are paid for by local burdens (e.g. risk concentration at a disposal site), and future generations will be affected by today’s decisions (or non-decisions) on disposal without actually having the benefits (Kasperson 1983; KASAM 1988; Shrader-Frechette 2000). This constraint of distributive fairness makes procedural aspects even more important.

The importance of and the relationship between safety and procedural aspects are intricate and have to be specified. First, we have to investigate what is meant by “safety”: There is a debate on lay persons’ demand for “absolute safety” versus the risk-orientated experts’ concept of “sufficient safety” (for a discussion see Flüeler 2006, 167 passim), which might have triggered the controversy on perceived (by the broad public) vs. “objective” risks, e.g. in terms of lethality rates (e.g. Fischhoff et al. 1978; Slovic 1987). However, determining the level of safety and the corresponding acceptable level of risk is a political issue (see Fischhoff et al. ’s question of 1978: “How safe is safe enough?”). Second, technical and non-technical issues meet in the site-selection process and the relevance of safety is discussed, e.g. whether the emphasis of the selection approach is technical (“safety first”) or participatory (i.e. voluntary, “acceptance first”, see Gunderson and Rabe 1999; Gowda and Easterling 2000; Bergmans et al. 2008). Third, to understand the interplay of safety and process, the distinct perspectives of different social groups have to be considered. This includes the question on the rationale of public participation (i.e. “substantive”, “instrumental” or “normative”, see Fiorino 1990) in radioactive waste management.

Forms of public involvement such as “information” or “consultation” (Rowe and Frewer 2005) have been undisputed, however, more committal forms of public participation, i.e. active involvement (Krüti et al. 2010) lead to the question whether and where lay persons (e.g. representatives of the public at large or stakeholders) can substantively contribute to safety. This interplay of safety, process, and expertise, is challenging, and has not been well understood in the perception of the problem so far. As a first step into this direction, we claim that knowing the preference of different social groups can already serve as a tentative indication where an acceptable mixture of this interplay could lie. Hence, the questions are:

- In the perception of the public at large and distinct stakeholders, what importance do safety and process aspects have, and do we find differences between groups that have already been affected by a site selection process and others, between proponents and opponents of a repository?
- To meet technical safety and societal needs, what can be learned from a contemporary (failed) project for the implementation of future site selection processes?

To tackle these questions we used different research methods and collaborated closely with actors and stakeholders from society, to integrate knowledge from outside academia and to foster mutual learning between science and society (Scholz et al. 2006). We denote such an approach as transdisciplinary, a form of knowledge
production that goes beyond university and complements traditional disciplinary and interdisciplinary scientific activities by integrating people from outside academia (Scholz et al. 2000).

The further structure of the article is as follows. In the next section, we present a transdisciplinary case study on the decision-making processes around the former repository project for low- and intermediate-level waste (LILW) “Wellenberg” in the Swiss canton of Nidwalden. This section includes information about the case area, a historical outline of the project, the study approach, the results and discussion. We close the article with a conclusion section. In this section, a brief overview on the recently launched new and novel Swiss repository site selection process is presented as well.

2. Transdisciplinary case study “Wellenberg”

In this chapter, we first present a short description of the case, including both the area of the canton of Nidwalden and the host municipality Wolfenschiessen as well as the decision process on the earlier repository project Wellenberg. This is followed by a presentation of the design and the methodological approach of the “Wellenberg case study”. Section 2.4 presents the results from a media analysis, a postal survey and in-depth stakeholder interviews. In section 2.5, the findings of the case study are discussed: How did the interplay between safety and fairness in the Wellenberg process work? What can be learned for future repository site selection processes? How can the divergent requirements of safety and process be balanced?


In the 1980s, Nagra (National Cooperative for the Disposal of Radioactive Waste), the company in charge of radioactive waste disposal established by the Swiss waste producers in 1972, undertook a site-selection procedure for an LILW repository. Even though the locality of Mount Wellenberg (see Figure 1) in the pre-alpine area of Central Switzerland in the Canton of Nidwalden had been analyzed, Nagra did not shortlist the site in their 1981 narrowing-down step.1 Two years later, they singled out three other sites as locations to continue with, among them Oberbauenstock2 in the same marl formation as Wellenberg but in the neighboring Canton of Uri (see Figure 1). Toward the end of 1985, the Cantonal Government of Nidwalden invited Nagra (without consulting either parliament or public) to explore Wellenberg as a fourth site. Later, the implementer focused entirely on this option. Strong opposition arose from the very beginning in the host and adjacent municipalities, specifically in Dallenwil, Oberdorf, and Stans (see Figure 1). The opposition managed to legislate a cantonal veto right, culminating in a cantonal vote against the LILW project in 1995. The application for a general license was rejected by the population (52% against; voter participation 72.2%). The host municipality, however, accepted the project by a 55.3% majority (voter participation 89.5%), i.e. the cantonal electorate overrode the host municipality’s vote. The rejection was especially strong (i.e. >60%) in the directly neighboring municipalities (Dallenwil, Oberdorf) and in the capital town of Nidwalden (Stans). The adjacent municipality of Engelberg in the canton of Obwalden had no voting right (see Figure 1). A survey among the cantonal population of Nidwalden after the referendum revealed that safety/risks issues,
Due to the rather close voting results (48% in favor of the project), and based on these findings, the implementer Nagra and the Government of Nidwalden continued the project. Some major revisions were made: to the concept (extensive in situ monitoring and retrievability), to the project and process (a stepwise approach starting with an exploratory shaft instead of a general license for a repository), to the compensation regime (it was extended to all municipalities of the host canton of Nidwalden and to Engelberg, however, still enormously privileging the host municipality), and toward inclusive expertise (a specially appointed pluralistic expert committee to advise the Cantonal Government). In 2002, the electorate again turned down a new project (57.5% against; host municipality: 55.6% in favor) and the project was stopped. There are no empirical data available to explain the repeated rejection in-depth. Apart from the arguments mentioned, there is evidence for a few explanatory factors. The voting rate was unusually high, i.e. > 70%. This is about 25% higher than the average percentage of voters in referenda in the last 25 years. It is reasonable to assume that the opponents were able to mobilize much better than the proponents of the project. Furthermore, there was a strong movement in the years before the first referendum to legislate democratic rights so that locals could have a say in the issue at hand, culminating in the rejection in 1995. Reconsidering the project, therefore, was considered an affront, as it puts a democratic decision into question. And one has to note that Nidwalden is a small
canton of 40,000 inhabitants, where social networks are strongly tied, where people were probably socially influenced and therefore rather immune to a change of mind (probably not least because of the emotionally driven campaign on both sides). This can be illustrated by the statement of a project opponent when asked to participate in one of the focus groups: “I’m seriously reflecting on my position, which I probably would not maintain in the future. However, I cannot take this reflecting position in public, as people in my personal and commercial surroundings would not understand this” (in a telephone interview on 14 November 2006).

2.2. **Case area – the canton of Nidwalden**

The canton of Nidwalden is situated in the pre-alpine central area of Switzerland (Figure 1). The canton consists of 11 municipalities, of which the potential host municipality Wolfenschiessen (Mount Wellenberg is in the close proximity of its major housing area) is by far the largest, covering about one-third of the cantonal area. The population density (Table 1) is below the Swiss average due to the mountainous topography. Nidwalden is dominated by services, crafts and industry and is experiencing an increase in population and income. The proportion of farmers is, however, still twice as high as Swiss average (8.9% vs. 4.5%). The average income is apparently higher than in most other Swiss cantons. This is due to three fiscally attractive municipalities bordering the Lake Lucerne. These contrast with the majority of municipalities, such as the potential host municipality, which has still an agrarian form. Its tax revenue is rather low and the tax rate is the highest in the whole canton.

The housing area of Wolfenschiessen as well as those of (most opposing) adjacent municipalities (Dallenwil, Oberdorf) is situated in a narrow valley accessible from one side only by road and railway. Adjacent to the host municipality but part of the neighboring canton of Obwalden is the well-known tourist resort Engelberg with Mount Titlis.

2.3. **Study organization and methodological approach**

The goal of the transdisciplinary case study Wellenberg was to investigate how the public perceives the importance of process and safety aspects and thereby to learn for future site selection processes from this contemporary example.

<table>
<thead>
<tr>
<th>Features of host canton/municipality</th>
<th>Host municipality Wolfenschiessen</th>
<th>Canton of Nidwalden</th>
<th>Switzerland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (km²)</td>
<td>93</td>
<td>276</td>
<td>41,285</td>
</tr>
<tr>
<td>Number of inhabitants (1995)</td>
<td>1993</td>
<td>39,803</td>
<td>7,459,100</td>
</tr>
<tr>
<td>Population density (persons per km²)</td>
<td>21</td>
<td>144</td>
<td>181</td>
</tr>
<tr>
<td>Number of municipalities (2009)</td>
<td>–</td>
<td>11</td>
<td>2715</td>
</tr>
<tr>
<td>Occupation in agriculture and forestry (2000) (%)</td>
<td>40.2</td>
<td>8.9</td>
<td>4.5</td>
</tr>
</tbody>
</table>

Note: Key features of Canton of Nidwalden and potential host municipality Wolfenschiessen as well as Switzerland. Source: Swiss Federal Office of Statistics.
To prepare the case study, an actor analysis was carried out with 20 face-to-face stakeholder interviews, among them the key players of the LILW project as well as all members of the cantonal government at the time. Based on the results, an Advisory Board was established with 20 persons from the Canton of Nidwalden. The rather large number of people allowed us to guarantee that different standpoints (varying with respect to political position, attitude to the project, gender) were represented in all meetings, even when some had no time to attend at a specific date. Its function was to introduce specific local information, experience, and interests, to establish contacts with further stakeholders and local experts, to recognize areas of conflict, and to ensure quality. There were three meetings during the whole study period, which discussed, for example, research questions, preliminary results, or conclusions. Furthermore, this body was included in the review process for the report (Scholz et al. 2007).

We established three research modules, namely, the “media module”, the “survey module”, and the “process module” (Table 2), each with a specific research method and a different time perspective: historical (media module); present (survey); and future oriented (process module). These research modules worked in parallel and autonomously but with continuous exchange of information and findings.

- In the media module, we investigated how much importance to both safety and process was given in the local media discourse as a first indication of the public’s perception. To this end, we identified the main actors and their arguments by means of a content analysis of articles and letters to the editor in the six local newspapers from 1989 to 2002. The purpose here was to analyze which arguments were used by whom, and how the pattern of arguments evolved over time.

- In the survey module, we strived to gain deeper insights into the perception of different aspects related to process and safety, as for instance risk and benefits, emotional concern, trust, justice and knowledge. We polled a representative sample of the Nidwalden population on the interplay of aspects like risk and benefit perception, concernedness, justice, value bearings, emotions, knowledge and trust. The postal questionnaire was a random electronic-directory sampling of 1790 households in January 2007 (according to the latest-birthday plus over 18-year-old rules). The response rate after two reminders was 30.7% \((n = 532)\), which is comparable to other surveys in Switzerland on risk related technical issues.

- In the process module, we wanted to identify with a future perspective, key aspects of process and safety and how they are assessed by stakeholders. Specifically, we were interested in the pattern of both differences and similarities between different stakeholder groups. We carried out in-depth interviews in an “exploration parcours” (single session in-depth interviews, see Scholz and Tietje 2002, 213 passim) with \(n = 41\) respondents selected by means of a stakeholder analysis based on the following criteria: participation in the Wellenberg process (cantonal stakeholders \(n = 18\) vs. national stakeholders \(n = 23\)), attitude toward nuclear energy, age and gender. Participants had to identify and weight major decision-making aspects, such as site-selection criteria, public involvement or monitoring.
Table 2. Key features of case study.

<table>
<thead>
<tr>
<th>Name</th>
<th>Major method</th>
<th>Preparatory work</th>
<th>Key features of method applied</th>
<th>Quality of data</th>
<th>Reference to result section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Media module</td>
<td>Content analysis</td>
<td>Checklist-based expert interviews to develop code book</td>
<td>6 local (regional) newspapers, 627 articles (out of 1400), 1487 arguments, 13 variables (e.g. date, length, origin and position of actor, argument)</td>
<td>Recoding of 60 articles, supplementary in depth interviews with 5 stakeholders supporting interpretation of finding</td>
<td>Figures 2 and 3</td>
</tr>
<tr>
<td>Survey module</td>
<td>Anonymous postal questionnaire</td>
<td>Focus groups with 26 persons ($m = 11$, $f = 15$), different political positions (anti-, pro-nuclear)</td>
<td>$N = 1790$ households, latest-birthday rule plus over 18 years-old, 2 written reminders</td>
<td>Response rate: 30.7% ($N = 532$), good representation (except for women and opponents, both underrepresented)</td>
<td>Figures 4 and 5</td>
</tr>
<tr>
<td>Process module</td>
<td>Exploration parcours (interactive in-depth interviews)</td>
<td>Eight expert interviews for relevant decision aspects</td>
<td>41 persons ($m = 30$, $f = 11$; 18 proponents of nuclear, 23 opponents to nuclear energy)</td>
<td>30-min introduction, 60-min interviews each with a possibility of second inquiries (by respondent and interviewer)</td>
<td>Table 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Actor-analysis based phone interviews to obtain contrasting groups</td>
<td>23 involved (cantonal actors), 18 external (national actors)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Overview of the methodology of the case study with three modules. All modules worked in parallel continuously exchanging information.
2.4. Results

The dominance of safety and process issues becomes evident in the “media module” (Figures 2 and 3). The newspaper analysis revealed that non-technical aspects (communication, trust, democracy) added up to 40% of all arguments used, both by proponents and opponents.

Figure 2. Results from media module.
Note: Proponents emphasised safety and communication, opponents focused on trust, democracy and (nuclear) energy policy in their media work. Source: Scholz et al. 2007, p. 42.

Figure 3. Results from media module.
Note: While “safety” and “democracy” had been the two major arguments in the 1995 campaign, the adherents of a site utilized “safety, technology” even more in the 2002 campaign, while their opponents focused on “site selection procedure” and “trust”. All wanted more “communication”. Source: Scholz et al. 2007, p. 47.
proponents and opponents of a disposal site, a figure that even increased in the letters to the editor, where “trust” ranked highest (not shown). As a single category, safety and technology was most often found, indicating that safety is certainly a prerequisite.

The relevance of the procedure is further underlined if we compare the difference in arguments put forward in the public debate after the 1995 vote (Figure 3). Major technical improvements after the first rejection (retrievability, etc. as mentioned) had stimulated the proponents of continuing investigation to emphasize technical aspects in the 2002 campaign, whereas opponents focused on procedural and trust issues, e.g. the pluralistic expert committee newly established by the canton which criticized the one-option-only approach by Nagra (KFW 2002).

What exactly is meant by “safety” is, however, ambivalent, as revealed by the “survey module”. With respect to the perception of risks, emotions and siting alternatives, it indeed proved to be the one central element of concern. That geology should be a principal safety barrier came out in the fact that 72% \( (n = 520) \) held that “deep geological disposal … is the best suitable long-term management of radioactive waste” (Scholz et al. 2007, p. 58). But the preparatory work, including four focus groups, showed that “safety” is a multifaceted issue, ranging from ground water contamination to transport of waste and (lack of) trust in experts, whereby diverging views on the part of experts made respondents feel insecure.

According to the survey, the importance of process aspects is highlighted in the response to the question on procedural and distributive (outcome) fairness (Figure 4). If a fair process led to one result only, this result would be accepted (this opinion was not stated in the context of safety).

When asked to specify requirements for a “fair process” the survey participants’ response pattern was homogenous: with an \( M = 4.0 \) to 4.5, \( SD = 0.59–0.94 \) (on a 5-point scale, where 5 means “very important”) over the entire sample and minor differences among proponents and opponents in the 2002 vote. Their conditions would be the following: a transparent and traceable procedure, inclusion of

Figure 4. Results from survey module.
Note: The degree of acceptance of any result is determined by the fairness of the procedure (mean, ±SD, 1–5 point scale). Source: Scholz et al. 2007, p. 66.
alternative sites, early and comprehensive information, possibility of active participation by those concerned, and resources for alternative expertise (Scholz et al. 2007, p. 63).

The relevance of process is strikingly demonstrated in the fairness pattern of a comparison of various (neighboring) municipalities (Figure 5). The municipality of Dallenwil (see Figure 1), directly adjacent to the siting community of Wolfenschis- sen as planned by Nagra, stands out with its perception of having been treated in an unfair way during the Wellenberg process. Residents must have felt directly affected by the planned repository in their vicinity (and by concurrent impacts from transportation and noise during the construction phase) but had not received as much attention from the applicant Nagra nor had they been given (or promised) any financial compensation, unlike Wolfenschisessen. Furthermore, this municipality was hardly involved in the process, as the implementer concentrated its information and negotiation activities on the potential host site, as participants from the focus groups repeatedly reported. The planned extension of the compensation scheme to Dallenwil did not change the voters’ minds in the second vote, of 2002 – with 62.9% against the community opted against the site even more than the cantonal average (57.5%).

If we finally look at the voting patterns of the respondents in the two votes of 1995 and 2002, we detect virtually no change: according to our survey, just 6% of the no-voters in 1995 voted yes in 2002, and only 3% did the opposite (Scholz et al. 2007, p. 65). This is remarkable since quite a few new aspects, some of them mentioned above, had been introduced for the second vote: Controllability and retrievability of waste was integrated into the disposal concept; exclusion criteria should allow abandoning the project in case of negative data; only an exploratory gallery and not

![Figure 5. Results from survey module.](image)

Note: Wolfenschisessen’s directly adjacent neighboring community Dallenwil feels more unfairly treated and less well involved than all other communities (mean, ± SD, 1–5 point scale). Source: Scholz et al. 2007, p. 65.
a full-fledged license application was submitted in 2002 to underline procedural staging; and the (financial) compensation scheme was extended to all communities instead of only to the (approving) targeted siting community.

The two aspects “safety” and “process/involvement” ran as pre-eminent topics throughout the entire investigation of the “process module”. The 41 respondents spontaneously mentioned the two most often as important aspects of a “good” (preferred) decision-making process, framed as an open question in the very beginning of the interview (Table 3, 26 and 23 entries, respectively). Both spontaneous entries and further aspects, which were derived from literature, were weighted by participants in the subsequent steps.

The weighting by the respondents reinforced the observation: highest importance was given to “involvement”, “safety”, and their potential link, “site-selection criteria” (as these consist of technical and non-technical aspects, such as release paths or erosion and spatial planning or conservation areas, respectively). Proponents and opponents did not show significantly different preferences. Some criteria are weighted as more important by directly involved actors: On a 10-point scale (from “unimportant” = 1 to “very important” = 10), those who had been involved in the site selection process of Wellenberg (n = 18) rated “selection criteria” (M = 9.2), “responsibility for site selection” (M = 8.6) and “size of repository” (volume of waste) (M = 6.9) higher than participants who had not been in the process (n = 23, M = 8.4 for “selection criteria”, M = 7.4 for “responsibility for site selection”, M = 4.7 for “size of repository”).

2.5. Discussion

The purpose of the study was to understand both the importance of and the interrelation between technical safety and procedural issues, using the example of the

Table 3. Results from process module.

<table>
<thead>
<tr>
<th>Aspects (spontaneous and supplied from literature)</th>
<th>Number of entries as important aspect</th>
<th>Mean weight (scale 1–10)</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of energy supply</td>
<td>6</td>
<td>7.9</td>
<td>6.9</td>
</tr>
<tr>
<td>Location of deep geological repository site (domestic/foreign)</td>
<td>5</td>
<td>7.5</td>
<td>7.5</td>
</tr>
<tr>
<td>Involvement of population (public involvement)</td>
<td>26</td>
<td>8.8</td>
<td>2.4</td>
</tr>
<tr>
<td>Accountability of decision process</td>
<td>4</td>
<td>7.9</td>
<td>3.9</td>
</tr>
<tr>
<td>Site-selection criteria</td>
<td>9</td>
<td>8.8 (9.2b; 8.4c)</td>
<td>1.5</td>
</tr>
<tr>
<td>Responsibility of site selection</td>
<td>3</td>
<td>8 (8.6b; 7.4c)</td>
<td>2.7</td>
</tr>
<tr>
<td>Safety philosophy of deep geological repository</td>
<td>23</td>
<td>8.8</td>
<td>4.7</td>
</tr>
<tr>
<td>Size of deep geological repository</td>
<td>&lt;3</td>
<td>5.9 (6.9b; 4.7c)</td>
<td>7.4</td>
</tr>
<tr>
<td>Type of compensation</td>
<td>4</td>
<td>5.3</td>
<td>7.1</td>
</tr>
<tr>
<td>Monitoring of deep geological repository</td>
<td>&lt;3</td>
<td>7.6</td>
<td>6.1</td>
</tr>
</tbody>
</table>

Note: Number of spontaneous entries of aspects (three per person maximum, top entries shaded) and mean weights of all aspects with variance (10-point scale from “unimportant” = 1 to “very important” = 10) (n = 41).

bSupplied from literature.

bInvolved in Wellenberg process: n = 18.

bNon-involved in Wellenberg process: n = 23, significant with p ≤ 0.05. Source: Scholz et al. 2007, 90, unpublished data.
earlier “Wellenberg” disposal project for low- and intermediate level waste. All our three research modules show that technical safety and procedural issues are of major concern. Safety is a prime issue and people recognize the need for disposal of radioactive waste in a technical system (deep geological repository). Furthermore, selection of a suitable disposal site has to be organized in a fair manner. It is worth noting here that it has been repeatedly demonstrated that a fair procedure influences people’s perception of the allocation outcome (“fair process effect”, see, e.g. Thibaut and Walker 1975; Lind and Tyler 1988). Fairness issues are of paramount importance in a situation where one region has to bear the burden while all others have the benefits (electricity). This is not surprising, as both procedural fairness and safety refer to vital concepts of human well-being. One relates to the need for protecting against harm, the other to the need of being treated fairly by others (e.g. Folger and Cropanzano 1998; Törnblom and Vermunt 2007) and having a “voice” (e.g. Lind and Tyler 1988; Thibaut and Walker 1978). However, the dominance of these two issues is the crucial point, as they might compete. A critical question is whether a fair involvement of all concerned can challenge the safety principle and vice versa. This can be tackled and probably overcome by closer collaboration in the sense of anticipating societal needs. This demands specific information and consultation forms to better reach a broad public. And this needs to start from the very beginning of a process as it can be shown by our data: the rather low changes on the voting patterns and specifically the case of the neighboring municipality Dallenwil illustrate nicely, how long-lasting flaws in the process are. On the other hand, the importance attributed to different process elements in the survey and the interviews makes us believe that a fair process can make a difference. It is, however, certainly only a necessary but probably not sufficient strategy to be followed.

We are confident that a better interplay can be achieved by combining two major approaches to siting. First, the currently more popular approach based on extended participation that gives the public decision-making power and on volunteering (DEFRA et al. 2008, p. 47) siting regions or communities as is done, for example but rather differently, in Sweden (Lidskog and Elander 1992; Elam and Sundqvist 2009) or Belgium with its “local partnership” approach (Hooft et al. 2002). In fact approaches with extended public involvement have become common in many different countries lately (see for a recent review the special issue of the Journal of Risk Research, Strandberg and Andrén 2009). Second, the more technical, safety-centered approach, where siting regions are pre-selected solely on technical (safety and geological) grounds and participation is mainly used to inform and consult the public. Each approach has a different bearing on the relationship of “geology” and “society”. A combined way would probably look like the one proposed by the German Committee on a site selection procedure for repository sites (AkEnd 2002; Hocke and Renn 2009). Similar to that and based as well on the lessons learnt at Wellenberg, the Swiss Federal Office of Energy on behalf of the Federal Government has launched a three-step procedure aimed at meeting safety requirements and extending public involvement (see Box 1). Through this stepwise and systematic approach and through the experience gained so far, the insights acquired from the Wellenberg failures have been put into practice. Both the concept itself and the experiences are in line with the insights gained from our study. We cannot claim that our research had a concrete impact on the design of the new procedure, as its development ran in parallel to our study. However, responsible people were involved.
throughout our study and were certainly supported in their approach chosen and most probably learned a lot for the current implementation. This can be illustrated by our observation that for instance the importance of process aspects became more dominant in the ongoing process and the balance between safety and process was certainly shifted to the latter.

3. Conclusion

We conclusively argue that the two contrasting approaches mentioned (i.e. “technical” and “participatory”) should and can be matched, thus meeting safety requirements as well as democratic needs. From the standpoint of safety first, which is not only the premise of the technical community but also, as we have shown, of society as well, public involvement must fit in with safety requirements; that is, participation must not increase risks due to a lack of adequate expertise. Risk characterization depends on

Box 1. Sectoral plan for deep geological repository.

The events of Wellenberg finally resulted in the preparation of a concept for a new site selection procedure (2002–2006) with a so-called sectoral plan, a planning instrument based on the Spatial Planning Act. Given the flaws and experience from the Wellenberg, a substantial consultation procedure was already set up from 2006 to 2007 on the concept and provided 11,300 responses (BFE 2008, p. 20). The concept was revised accordingly and approved by the Federal Government in spring 2008, and the procedure was launched in November 2008. It consists of a systematic screening of geologically suitable sitting regions and a final selection in a three-stage procedure over one decade (BFE 2008). The new Nuclear Energy Act (in force from 2005) does not allow a cantonal veto on nuclear matters. The final decision will rest on the national level, i.e. the decision will be taken by the Federal Government and the Parliament, which will probably be followed by a (facultative) national referendum. Consequently the final decision lies in the hand of the Swiss national electorate.

In the technical (“safety first”, i.e. no principle of voluntarism as e.g. in Sweden, see Elam and Sundqvist 2009, Lidskog and Elander 1992) approach, the first screening step is to list suitable geological sitting regions, a task which is up to technical specialists. In this – ongoing – Stage 1, Nagra has to propose technically suitable sitting areas based on safety criteria. In the potential sitting regions the population must be involved early on. An extensive consultative regional participation is currently being prepared. This stronger emphasis on participation, but still giving safety priority, runs through the whole new procedure and is a clear lesson learnt.

In Stage 2 (from 2012), the proposed sitting regions will have the opportunity to co-determine the content of the siting projects with respect to above-ground buildings and participate in studies on the socioeconomic effects and spatial planning impacts. Nagra will carry out further geological studies, preliminary safety assessments, and safety comparisons before it proposes at least two sites each for low- and intermediate level waste and high-level waste.

In Stage 3, the remaining sites will be studied in greater detail. With input from the sitting region, the socioeconomic studies will be intensified. The sitting regions will propose projects for regional development and define principles for any necessary compensation measures, as well as for monitoring the socioeconomic and ecological impacts. Finally, Nagra will submit applications for two licenses (one each for high-level waste and low-/intermediate-level waste), or for one license for two repositories at the same site (around 2016–2018). A facultative referendum at the national level (public vote) will most probably complete the procedure.

Note: The concept includes a three-step siting procedure for the disposal of radioactive waste.
knowledge, skills, and experiences. Therefore, technical risk assessment is predominantly considered to be a matter for experts. Active forms of public participation in the sense of public reviewing, that is, challenging technical experts by asking critical questions from various perspectives could certainly be fruitful, and may stimulate the technical community to find the best available solutions. This does, however, not mean that the experts’ work can be replaced, and this form of public involvement is, furthermore, not in competition with the technical regulator; rather, it can be seen as a complementary element resulting in more robust technical solutions (Flüeler 2006).

Furthermore, the (local) public may identify important issues based on specific (local) knowledge and experience, and therefore drive the technical analysis (for a detailed discussion of such a functional and dynamic approach to public involvement, see Krüttli et al. 2010). We finally conclude that through such a balance between “technical” and “participatory” requirements, the concerns evident in our case study about these two partly competing but clearly pre-eminent issues can be taken into account. As such the lessons from the Wellenberg case could be truly learnt.

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Notes
1. For a comprehensive account, see Flüeler 2006; for a content analysis from 1981, see Flüeler 2002.
3. “Wellenberg process” refers to the long lasting decision-making process on the LILW repository project Mount Wellenberg in the municipality of Wollenschissens.

References


