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To cite this article: Karel Svačina (2017) How (not) to talk about the uncertain: siting geological disposal for highly radioactive waste in the Czech Republic, Journal of Risk Research, 20:9, 1211-1225, DOI: [10.1080/13669877.2015.1121901](https://doi.org/10.1080/13669877.2015.1121901)

To link to this article: <http://dx.doi.org/10.1080/13669877.2015.1121901>



Published online: 08 Jan 2016.



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How (not) to talk about the uncertain: siting geological disposal for highly radioactive waste in the Czech Republic

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(Received 24 August 2014; final version received 9 November 2015)

There is an ongoing controversy in the Czech Republic over where to site a deep geological repository for the country's radioactive waste. Recently, the negotiations between municipalities and state authorities responsible for radioactive waste management experienced a sharp turn: after several years of dialogue guaranteed by the promise of the state authorities not to start site investigations at preselected sites without the consent of affected municipalities, the state authorities suddenly decided not to keep this promise, and to start site investigations without the municipalities' consent, saying that time for dialogue will come after the site investigations will have been completed. This article explores the period of the failed dialogue with respect to how risks and uncertainties were treated in the negotiations. Drawing on two strands of scholarship on risk and uncertainty, the risk governance school and the STS perspectives on sociotechnical controversies, two paradigms for dealing with risk and uncertainty are outlined. These are used as a framework to analyse how implementers and local stakeholders articulated possible risk or uncertainty issues in negotiations about the Czech geological disposal between 2009 and 2013. The analysis shows that whereas the implementers adopt (sometimes even an extreme version of) the risk-based paradigm, the positions of the local stakeholders seem to be mixed. These observations lead to two conclusions: first, at the theoretical level, perhaps some of the STS literature was too quick to assume that people 'want' uncertainty. Second, at the practical level, it is suggested that in the light of the failed dialogue, it might be worth for the implementers to take a lesson from the uncertainty-based paradigm, and consider the possibility that perhaps still more work needs to be done in order to turn uncertainty into risk.

Keywords: siting; geological disposal; radioactive waste; uncertainty; risk; Czech Republic

Introduction

Siting geological disposal for high-level radioactive waste is a complex and intricate issue. Many countries have chosen the construction of deep geological disposal as their final and permanent solution to the problem of high-level radioactive waste, but the proposal to build the repository often turned into an enduring controversy over where to do so (cf. e.g. Jacob 1990; Flynn et al. 1995; Sundqvist 2002).

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The Czech Republic is no exception in this respect. The efforts to find a site for the country's highly radioactive waste date back to the 1990s, and have experienced several twists and turns since then. The last one took place in 2013, when state authorities suddenly decided to proceed with geological site investigations against the consent of the concerned municipalities, despite the fact that for the past several years they had been emphasising the need for dialogue, and they were promising the municipalities not to start the investigations without their approval.

The period of dialogue that preceded this turn can be seen as a failure, both from the implementers'¹ as well as the local stakeholders' view. Whereas the implementers argued that the reason for the twist in their strategy was that the dialogue did not bring progress they had expected, local stakeholders were left feeling deceived and betrayed by having been given promises that suddenly vanished into thin air (Konopásek and Svačina 2014). This article aims to investigate one circumstance that possibly contributed to this failure – the way risks and uncertainties were treated during the 'dialogue' period of 'the' Czech controversy.

There are many unresolved issues in the project of geological disposal. There are scientific controversies related to the safety case of the repository (Kärnavfallsrådet 2011; Szakálos and Seetharaman 2012). Local stakeholders often express concerns about nature protection, future availability of drinking water, or the development of the local real estate market. These issues are numerous, and as implementers strive to proceed with the disposal project, they need to be dealt with somehow. This article is concerned with how this is done in the Czech case.

In risk literature, the concepts of risk and uncertainty are often discussed together (e.g. Beck 1992; Renn 2008; van Asselt and Renn 2011). However, their relationship has been subject to a long debate. In this respect, de Vries, Verhoeven, and Boeckhout (2011) have recently argued for a new approach in risk governance, one that stems from a constructivist reconsideration of the relationship between risk and uncertainty. Following their argument, two paradigms for risk governance can be identified, a 'risk-based' one, and an 'uncertainty-based' one. In this article, these two paradigms are going to serve as the framework for analysis of the Czech debate on geological disposal. The goal here is not to say whether an issue is a case of risk or uncertainty; nor is it to say which of the two paradigms is better. The goal is to see how, during the 'dialogue' period which took place roughly between 2009 and 2013, risk or uncertainty issues were treated by different actors in different situations, particularly whether they were treated in the spirit of the risk-based, or of the uncertainty-based paradigm. Because the differences in the assumptions of the two paradigms are quite fundamental, such analysis may provide a new insight into the failed Czech dialogue.

A first-hand explanation of the controversy in the analytical framework proposed here would be that local stakeholders incline towards the 'uncertainty-based' paradigm, while implementers incline towards the 'risk-based' paradigm. Such explanation is suggested in some literature on risk, uncertainty and sociotechnical controversies (e.g. Wynne 2002; Callon, Lascoumes, and Barthe 2009), and initial observations of the Czech case would also support it. However, a closer examination shows that in the Czech controversy this is not exactly the case. In this respect, the article also aims to contribute to the debate on the relationship between risk and uncertainty and on the nature of sociotechnical controversies.

A risk-based and an uncertainty-based paradigm in understanding sociotechnical controversies

The conceptual framework employed in this article draws on two lines of scholarship on risk and uncertainty. One comes from the risk governance tradition (e.g. Klinke and Renn 2002, 2012; IRGC 2005; van Asselt and Renn 2011), the other comes from constructivist perspectives on risk and uncertainty in science and technology studies (Wynne 1992, 2002; Callon, Lascoumes, and Barthe 2009). Although in many ways different, these two bodies of scholarly work share some key academic and practical concerns, above all, how to understand and deal with techno-scientific issues in conditions of uncertainty (cf. van Asselt 2005). This section will introduce the concepts of risk and uncertainty with respect to these two lines of thinking, and in relation to the geological disposal controversy. The aim is to find common ground for the delineation of risk and uncertainty, but also to point out some differences between the two perspectives, in order to be able to arrive at the distinction between the ‘risk-based’ and ‘uncertainty-based’ paradigms for risk governance.

The concept of risk is commonly used to refer to a possibility of harmful outcome or damage (van Asselt and Renn 2011; 437). In the geological disposal case, this could be for instance a possibility of environmental damage due to the construction of the repository, or the possibility that property prices will fall dramatically in the affected municipalities. Uncertainty is somewhat more difficult to define in general. It has been referred to as a situation where there is ‘*lack of knowledge*’ (de Vries, Verhoeven, and Boeckhout 2011, 489). But it has also been argued that ‘uncertainty does not necessarily precede knowledge, but it may originate from it’ (van Asselt 2005, 132) – more knowledge does not necessarily mean less uncertainty. Therefore, instead of linking uncertainty with lack of knowledge, one can say that in general, uncertainty refers to the limited possibilities or abilities to predict the outcome of a situation or activity.² Of course, uncertainty in a general meaning is a condition of human life; however, the specificity of uncertainty in the context of sociotechnical controversies is that here, science and expertise meets lay people’s knowledge in decision-making processes where a lot is at stake, many outcomes are impossible to predict, and there is a usually a ‘*desire or incentive to act*’ (131).

Scholars in risk governance and in science studies have approached the relationship between risk and uncertainty in fundamentally different ways. The risk governance tradition has developed distinctions between different types of risk, in particular ‘simple’, ‘complex’, ‘uncertain’ and ‘ambiguous’ risks, arguing that each category necessitates a different management strategy (IRGC 2005, 44–48; Renn 2008, 177–184). In this sense, the risk governance tradition has significantly broadened the notion of risk from ‘traditional risk–risk comparisons (or risk–risk trade-offs)’ (Renn 2008, 178). In doing so, risk governance has contained the notion of uncertainty within the notion of risk, to the extent that some risk governance scholars deem the adjective ‘uncertain’ in ‘uncertain risks’ superfluous, and prefer to drop it altogether (Aven and Renn 2009, 2; Rosa 2003 cited in van Asselt and Renn 2011, 444). In contrast, some scholars in science studies have argued that the notion of risk comes historically from the vocabulary of engineers, economists, and insurers, in whose trade risk was always something that could be calculated, and it should remain to be used in this way (Callon, Lascoumes, and Barthe 2009). For these scholars, risk is when we know the inventory of possible states of the world, or

scenarios, as well as their probability distributions (19–20), or in other words when we ‘know the odds’ (Wynne 1992, 114). As a result, science studies scholars have insisted on the strict analytical separation of risk from uncertainty, and they have gone to focus on developing the latter notion.

On the one hand, these two lines of thought are not that much different. Where science studies scholars make a distinction between risk and uncertainty, risk governance scholars make a distinction between simple risks and uncertain, complex, and/or ambiguous risks. In both cases, the emphasis is on the latter group, saying that the former group is a special case, and in both cases it is argued that issues are too often treated as if they belonged to the first group (Callon, Lascoumes, and Barthe 2009, 228; van Asselt and Renn 2011, 438). In this sense, to insist on the difference between these two lines of thought may be seen as splitting hairs, a mere vocabulary issue. However, at closer look the difference between these two lines of thinking is more fundamental, to the extent that we can speak of two paradigms for understanding risk and uncertainty in sociotechnical controversies. The difference was recently highlighted in a report by the Dutch Scientific Council for Government Policy *Uncertain Safety* (WRR 2009), and its more condensed version in de Vries, Verhoeven, and Boeckhout (2011). Taking a constructivist perspective common in science studies, the authors of these reports argue that risk is already a result of heterogeneous work and effort done by different actors, and attention needs to be paid to how risk is constructed.³ That is why, according to them, ‘analytically *uncertainty deserves pride of place over risk*: risks may emerge out of uncertainties, not the other way around, and they will do so only after considerable efforts have been undertaken.’ (491)⁴

Giving analytical pride of place to uncertainty over risk has practical implications for dealing with sociotechnical controversies. De Vries, Verhoeven, and Boeckhout argue that today, policy-makers often face issues that do not fit, or may move between the categories developed in the risk governance tradition. Therefore, it is too often misleading to settle for one category of risk for a given problem (487–489). To be able to deal with such issues, they call for a broader, uncertainty-based approach to risk governance, as a ‘society’s framework for *taming* (safety issues related) *uncertainty*,’ whose purpose is ‘to *organize* the efforts needed to translate uncertainty as far as possible into risk.’ (491) Therefore, if we follow the argument of the WRR (2009) and de Vries, Verhoeven, and Boeckhout (2011), we arrive at two paradigms for dealing with sociotechnical controversies, which stem from the two lines of thinking presented above: a risk-based, and an uncertainty-based paradigm.

This paper aims to analyse the Czech geological disposal controversy in terms of these two paradigms. But in order to use the two paradigms as a theoretical framework, some more work needs to be done. At the theoretical level, it is easy to make a distinction between the two paradigms (‘giving analytical pride of place to risk or uncertainty’), but how does this difference translate into practice? The parties in the controversy will not explicitly endorse one of the paradigms or the other, nor is it possible to say that if someone talks about ‘risk’, then that person prefers the risk-based paradigm, or when someone talks about ‘uncertainty’, then that person prefers the uncertainty-based paradigm. So what are some of the preferences or characteristics within these paradigms that account for the difference between them?

The risk-based paradigm prefers the idea of risk over the idea of uncertainty. The notion of risk is historically linked with the effort to calculate its probability. In case

of complex, uncertain and ambiguous risks in risk governance, there is a consistent effort at the ability to control and manage these phenomena. Risks are categorised, different evaluation, management and communication strategies are advised (Klinke and Renn 2002, 2012), scenarios are sketched out. Dealing with risks is delegated to experts: in some cases, public involvement is increasingly being advised, but it usually pertains only to certain phases of the risk management process, and its organisation is in the hands of risk governance experts. Scientific risk assessment belongs to different stages than public involvement. Dealing with risks may also include calculating the costs of the damage, and compensating for this damage (IRGC 2005).

In the uncertainty-based paradigm, on the other hand, the idea of uncertainty is preferred. Risk becomes a special case. This paradigm asserts that it is often difficult or impossible to outline specific management strategies or the inventory of possible scenarios in advance. Instead, emphasis is put on 'proactive approach to uncertainty' (de Vries, Verhoeven, and Boeckhout 2011, 493). Uncertainties are put centre stage, and the goal is to explore them. This is a *collective* and progressive effort (Latour 2004; Callon, Lascoumes, and Barthe 2009). In this sense, the separation between expert and lay people's knowledge is in some cases blurred. In terms of 'risk management', it means a shift of focus from damage to vulnerabilities (de Vries, Verhoeven, and Boeckhout 2011), and there is a wider emphasis on precaution (Wynne 1992).

These two lists delineate the two paradigms perhaps quite crudely, but the aim is to draw two distinct positions that will serve as the framework for analysis, to which we shall turn after a brief introduction to the Czech geological disposal controversy.

Looking for a site for geological disposal in the Czech Republic

The Czech geological disposal programme dates back to the early 1990s, when the Czech Geological Survey identified 27 areas across the Czech Republic as potentially suitable for geological disposal. This selection was based on existing geological data (Krajčiček et al. 2006, 17). The 27 areas were further assessed by the Nuclear Research Institute, which resulted into a preliminary selection of 8 locations within 5 of the 27 areas. In 1997, the Radioactive Waste Repository Authority (SÚRAO) was established. In 2001, the government approved a document called 'Strategy for the management of radioactive waste and spent nuclear fuel' (MPO ČR 2001). This document states that the preferred solution for long-term management of highly radioactive wastes in the Czech Republic is deep geological disposal in granitic environment (15). The document also outlines a schedule for the geological disposal project. This schedule states that by 2015 two sites 'with the best geological conditions and in accordance with the expected regional development' are to be identified. By 2025, one of these localities is to be confirmed as the final one; by 2030 the construction of an underground laboratory is to be started, and the repository is supposed to start operation in 2065 (22).⁵

The plan to construct a geological disposal facility became a public issue in the early 2000s, when a number of municipalities learned from the media that they were being considered as potential sites for geological disposal.⁶ A wave of local protests followed, culminating with a demonstration in front of the governmental offices in Prague. NGOs engaged in nuclear waste and energy issues helped the municipalities organise local referenda, in which large majorities of people voted against the

prospect of the repository. Partly in response to these developments, in 2004 the minister of industry and trade declared a five-year moratorium on the siting process.

After the moratorium ended in 2009, negotiations resumed. The list of pre-selected sites remained more or less the same, but the shape of the negotiations changed significantly. Rather than talking about the repository, the implementers started emphasising the need to carry out site investigations. Much emphasis was being put on dialogue; a national ‘Working group for dialogue about geological disposal’ was established, which brought together municipal and NGO representatives from all the concerned sites as well as representatives of SÚRAO and other state institutions. Between 2009 and 2012 SÚRAO also organised a number of public debates at the concerned sites. Perhaps most importantly, SÚRAO was in this time period repeatedly declaring that the site investigations would not start without the consent of the concerned municipalities, and that the consent with site investigations would not imply consent with the repository.⁷

In 2012, SÚRAO proposed to sign contracts, in which municipalities would express their consent with the site investigations. Several municipalities at two sites were about to sign these contracts, however, strong local opposition at these sites broke out again, and in the end the municipalities refrained from signing the contracts. What followed was a sharp turn in the implementers’ approach. In early 2013, SÚRAO representatives declared that the strategy based on obtaining first the consent with site investigations was not feasible, and that they would first carry out the site investigations, and then discuss the siting problem with the concerned municipalities.⁸ In other words, the siting strategy based on dialogue failed, and the implementers turned (back) towards a more ‘technocratic’ decision-making. The municipal and NGO representatives were left with a bitter feeling of having been deceived.⁹

Understanding the failed dialogue through the two paradigms

The failure of the dialogue at the end of 2012 can be attributed to a mixture of different reasons (Konopásek and Svačina 2014). The aim of this paper is to investigate one ingredient of this mixture – the way risks and uncertainties were treated in the negotiations. To do so, this section will follow the implementers and local stakeholders across several different settings. The aim is to see whether and how the two groups articulate issues of risk and uncertainty, how they relate to them, and what strategies they use or advise in dealing with them, especially in relation to the risk-based and uncertainty-based paradigms.

This research strategy is simplifying at least in two respects. First, the selection of the particular situations and data cannot claim to be representative in the sense that they would reveal the actors’ positions in their complexity. The data were collected mostly by the author between 2011 and 2014 as a part of the InSOTEC project, and consists of qualitative research interviews with key actors in the controversy, observations from meetings and public debates, technical reports, policy documents and media articles. The particular excerpts selected in this article are obviously only brief glimpses at the long and complex negotiation process. Nevertheless, the present selection of data is based on the author’s several years long experience following the controversy, and the author believes that it represents behaviour and positions that were typical for the parties involved in the controversy during the dialogue period. Second, the two groups of stakeholders outlined here are far

from homogeneous; especially vis-a-vis local stakeholders, every site has its specific conditions and concerns. Moreover, at each site there are municipal representatives, farmers, industrial workers, holidaymakers and NGOs, all of whom may have different interests, and all of whom will be conflated together here into one category. Nevertheless, it is believed that such simplifying research strategy is legitimate and potentially fruitful here, as it may help understand the prevailing positions in the controversy.¹⁰

Implementers

At a public meeting in a village called Věžná in April 2012, SÚRAO's director of the geological disposal programme was presenting the Czech repository project.¹¹ He identified 'three pillars' of constructing a safe repository. The first pillar was called 'How?', and it was concerned with the technical solution. The director talked about the natural and engineered barriers; he reiterated that there is an international consensus on this concept, and that such design is a result of 'generally accepted solutions that the scientific community has agreed upon in the past' (Public meeting in Věžná, 12 April 2012). The second pillar was called 'Who pays?' Here, the director pointed out the Czech 'nuclear fund',¹² and concluded that 'the Czech Republic is clearly one of the countries that have established a financial system that is able to cover the costs of the future geological disposal.' (Ibid.) The third pillar was called 'Where?' On the slide, it was followed by an inscription in red capitals: 'SITE!!!' The director introduced it as follows: 'The third pillar is, however, 'where'. That is the question of the locality and one can say that it is one of the key problems which each country has to face when constructing geological disposal.' (Ibid.) The director went on to explain that the site will need to be chosen on the basis of geological investigations, which 'will be carried out in a relatively simple manner ...' (Ibid.) And how will the final selection be made? 'The fundamental criterion is naturally the safety of the future repository, but naturally ... it is also important how much it will cost, and what the activity – the construction of the repository and its operation – may bring to the region.' (Ibid.) Finally, it was emphasised that it is important for SÚRAO to choose the final site in a way that in the long term will be acceptable for the concerned municipalities as well as for the public.

How is risk or uncertainty treated here? First of all, neither risk nor uncertainty is explicitly mentioned. The issue of geological disposal is divided into three distinct questions ('How', 'Who pays', 'Where'), which are to be dealt with separately. The first question is regarded as a matter of scientific and technical expertise upon which there is an established scientific consensus. The second one is a matter of legal arrangement that is already in place. They are both 'technical', and importantly, neither of them poses any major problems. They are delegated to science and expertise. The third question, 'Where', is further separated into two. There is again a 'technical' part (geological research needs to be done), which is not seen as a problem: geological research will be 'relatively simple'. But then there is a 'social' part (consent of the municipalities needs to be obtained). This is seen as the main problem. SÚRAO needs to make the selection in a way that people 'will not protest in front of the Office of the Government of the Czech Republic' (Ibid.). There is an implied uncertainty as to what the attitude of the municipalities will be.

Konopásek and Svačina (2014) describe how SÚRAO emphasised the need for dialogue between 2009 and 2013, and how ultimately, this dialogue was translated

into the quest for the municipalities' consent with the site investigations. They note a number of gradual changes that indicated the re-making of the organisation towards a more active relationship with the public and local stakeholders (13–21). Here it is important to note that SÚRAO framed all activities under these changes as 'communication' or 'public relations' activities.¹³ This framing can be seen being closer to the risk-based paradigm than the uncertainty-based paradigm. It perpetuates the separation of the geological disposal issue into technical parts and social parts. While the technical parts are delegated purely to technical experts, social parts are delegated to PR professionals. Furthermore, the PR-founded activities tend to present the geological disposal project as a ready-made solution, which 'only' needs to find its place, and whose purpose needs to be communicated well to the local stakeholders (this logic was apparent also in the presentation discussed above). In other words, possible uncertainties in the project itself are in practice left out of the public debate. At the same time, the contracts that SÚRAO proposed to sign with the municipalities would in effect 'contain' the uncertainty about what municipalities would do, while providing room for SÚRAO to work on the (technical) site investigations. In short, these practices of issue and knowledge separation, delegation, uncertainty containment and secluded research resemble the risk-based paradigm much more than the uncertainty-based paradigm.

Let us now have a look at some other sources of data – key technical documents. In 1999, a 'Reference Project' was created (EGP Invest 1999). It is a technical project of the repository at a hypothetical location, and it also includes the EIA report (Lietava et al. 1999).¹⁴ The EIA report provides a framework for risk analysis of the impact of the future repository to human health and the environment. It weighs different scenarios and assesses different models of possible impacts. In this respect, it points out uncertainties related to input data and to the models of behaviour of the disposal system (Lietava et al. 1999, 38). Possibilities of dealing with these uncertainties in safety assessments are then discussed, and calculation using parameters from the hypothetical site is presented. The EIA report emphasises that due to the hypothetical nature of the site, the conceptual and mathematical models and calculations should be seen as an illustration, and should not be considered relevant for the next steps in geological disposal development (Lietava et al. 1999, 43, 51). However, despite this warning, the summary report of the Reference Project concludes that 'the disposal system does not endanger the health of the future generation or the environment. Technological procedures ensure permanent isolation from the environment. Technical solution eliminates all risks (radiation, toxic, or heat related).' (EGP Invest 1999, 39)

A more recent update of the Reference Project (Pospíšková et al. 2012) shows similar argumentation. After discussing uncertainties due to the unavailability of input data, and due to the fact that the engineered barriers have not been specified yet (92), the report concludes:

Nevertheless, these calculations have clearly demonstrated that the disposal of radioactive waste into a deep repository based on the updated Reference Project is safe and cannot endanger human health or the environment, provided that over the next several decades that remain before the assumed start of the operation of the repository (2065), it will be proven and demonstrated that all the engineered and natural barriers will fulfil their safety roles as expected. (Ibid.)

What kind of work with risk or uncertainty is at play in these documents? The EIA report of the Reference Project articulates uncertainty which consists largely in the hypothetical stage of the project. Subsequently, this uncertainty in both the original and the updated Reference Projects disappears. The Reference Project (Lietava et al. 1999) reduces it to a definite set of risks, and states that these are *all eliminated* by technological procedures and technical solution. What we see here at work is again delegation, this time to technical solutions and procedures (no matter that these have not been devised yet).¹⁵ Similarly in the updated Reference Project (Pospíšková et al. 2012), the impossibility to discuss uncertainty due to the fact that its existence is uncertain, serves as grounds for not considering it further. As a result, if we rephrase the concluding statement quoted above, it says: ‘it has been clearly demonstrated that our disposal project is safe, provided that it will be proven and demonstrated in the future that the repository is safe as we expect it to be.’ This statement says that at the moment we can say nothing about the safety of the repository, but the starting point is that it is absolutely safe.¹⁶

On the one hand, one can argue that these documents are supposed to serve ‘just’ as a reference, or a starting point of the project of the future geological disposal facility at a hypothetical location, and therefore hypothetically and as a reference it is legitimate to state that the project is safe. On the other hand, the uncertainty-based paradigm emphasises precisely the opposite: the ‘proactive search for uncertainty’ and the focus on vulnerabilities.

To conclude this section, the presented examples showed the implementers’ approach to dealing with risk or uncertainty as mainly that of separating the issue of geological disposal, and delegating different parts to different groups of experts or procedures. Uncertainty has been hardly articulated, and in the few cases where it was, it was subsequently replaced by a reference to a limited set of risks, despite (or perhaps due to) the acknowledgement that there was in fact uncertainty about the uncertainty. Accordingly, no practices that would suggest proactive search for uncertainty, collective exploration of uncertainty, or focus on vulnerabilities were found.¹⁷ In this sense, we can conclude that in handling possible risk or uncertainty issues, the implementers of the Czech geological disposal project incline towards the risk-based paradigm (or perhaps even a caricature of it).

Local stakeholders

This section will present several examples of how during the ‘dialogue period’ local stakeholders articulated possible risk or uncertainty issues in response to, or in confrontation with, the claims of the implementers. First, the presentation in Věžná was followed by a discussion with local inhabitants. One of the questions raised concerned SÚRAO’s internal quality control to prevent environmental damage during the repository construction:

I am interested in what kind of internal regulations you have, or how you want to proceed ... to ensure the quality of the safety. I assume that the disposal itself will be of course closely observed. What I am more interested in is, when all this is going to be built, it obviously means environmental burden ... how is this going to be done so that it is safe? What control mechanisms do you have? (Public meeting in Věžná, 12 April 2012)

The SÚRAO representative responded in two parts. First, he argued that every construction work needs to be approved by relevant authorities. In relation to this, he emphasised that SÚRAO is a state organisation, and that itself should be the highest possible guarantee.¹⁸ Second, he argued that it is a question of ‘all of us who are sitting here now, and who will be around the project,’ to not let the environment be damaged (Ibid.). How to understand this exchange? The question articulates a risk of environmental pollution (the possibility that the environment will be damaged). At the same time, it sees the environment as vulnerable in relation to the construction works, and asks about precautionary mechanisms *within* SÚRAO – the responsible organisation. Emphasis on vulnerability and preventive measures is in line with the uncertainty-based paradigm. However, the answer shifts responsibility from the implementing organisation elsewhere (to legislative framework and to ‘all of us’), which can be seen as contradictory to the uncertainty-based paradigm (de Vries, Verhoeven, and Boeckhout 2011, 493). In this sense, the question is raising concerns that are in line with the uncertainty-based paradigm, whereas the answer does not correspond to this paradigm.

Second, a citizen association at one of the preselected sites published several leaflets in 2012. One of them features an article called ‘What we could expect ...’ (Kantová 2012). It is a partly fictional scenario of the repository development. It combines milestones from the governmental schedule with potential benefits associated with the project, such as ‘construction of a sports hall financed by contributions for site investigations’. It also includes a number of possible adverse effects. For instance, it states that by 2018, twenty per cent of the local forest is ‘devastated by new necessary access roads, concrete base, and a waste pond for the very deep drills.’ By 2020, young people are leaving the area, and the property prices have fallen dramatically. After 2030, due to the construction of an underground laboratory, the water level in local wells falls dramatically, and the wells become unusable. The article concludes: ‘This scenario may seem to you more catastrophic than a Steven Spielberg movie, but no one has convinced me so far that it cannot happen.’ (Ibid.) On the one hand, this scenario can surely be seen as a caricature of how the disposal project and the construction works are presented by the implementers. On the other hand, it can also be seen as an alternative scenario, one that questions the scenario presented by the implementers, and one that adopts the strategy of proactive search for uncertainties by including people’s concerns that have not been answered satisfactorily by the implementers.

The leaflets also contain several articles written by a local geologist, which question the proposed geological investigations. In one of them, the geologist argues that up to one thousand metres deep drills into granite, which were included in the proposal, have never been done in the Czech Republic before, and that such drills would necessarily mean quite severe environmental burden for the area. It is further pointed out that SÚRAO does not have the technical competence to carry out such drills, and it is argued that SÚRAO representatives deliberately downplay the extent and environmental impact of these drills (Svejkovský 2012a, 2012b).¹⁹ In these examples, local stakeholders mobilise their own expertise, and directly challenge the implementers’ claims that the site investigations will be ‘carried out in a relatively simple manner’. Where the implementers are confident about technological procedures, local stakeholders suggest lack of skills and previous experience, and in this way they articulate uncertainty on the way towards the proposed technical solution. The mobilisation of their own expertise and effort to engage it in the controversy

can be seen as an attempt to create a ‘hybrid forum’ (Callon, Lascoumes, and Barthe 2009), one of the devices typical of the uncertainty-based paradigm.

Third, let us turn to an interview with a representative of a local citizen association from another site. He argued that there are many risks related to the disposal project, but people in the municipalities suffer from lack of information about the risks, and therefore they cannot make their opinion about it. He argued that SÚRAO does not invite people from ‘the other side’ to their debates:

They should also invite experts ... I do not mean people who would say ‘do not build it here’, or ‘it is wrong’. I mean people who would say, ‘there are some risks and we see them such and such.’ I think it would be useful even for SÚRAO and for the people ... that they would finally hear that it is not only white and beautiful. That there are also some black things, and they would have an opportunity to compare these. (Research interview, 3 January 2013)

When asked what the risks according to him were, he continued:

Some of them are those that can easily be refuted in the sense that we can discuss them for a long time. These are first and foremost, that young people will not stay in the region. ... Another risk is the project itself, controlled by the state – in other words, by no one. For me, the state is not a partner. ... And further, if you talk to [a national NGO representative focusing on energy issues and nuclear waste], and similarly to the State Office for Nuclear Safety, they confirm that SÚRAO does not deal with safety risks. They do not talk about risks at all. (Ibid.)

How to understand this account in terms of the two paradigms? First, the interviewee uses the word ‘risk’, not ‘uncertainty’. But what are the issues that he mentions? One is whether or not young people will stay in the region – here he suggests that despite a long discussion, the outcome is unpredictable. Next, he points to the vague identity of the state as the guarantor of the project, which in his opinion is not accountable. In short, in terms of the outline between risk and uncertainty employed in this article, he is talking about instances of uncertainty rather than risk. But does that mean that his approach fits the uncertainty-based paradigm? Not clearly. Throughout the interview, he has repeatedly referred to experts who should participate in the debates and *present* the ‘risks’ to the people. He asserted that the implementers should know the risks, and if they do not know them, ‘then it is wrong’ (Ibid.). Furthermore, when asked whether people should discuss also the technical parameters of the repository and what the repository will ‘look like’, he said that many people were ‘not very interested’ in these issues, and they are ‘not able to perceive the technical parameters very much’. (Ibid.) In other words, the interviewee also articulates a distinction between expert and lay knowledge, where experts should ‘know the risks’ and communicate them to the people, so that they can decide about their fate. Such perspective is closer to the risk-based paradigm than to the uncertainty-based paradigm. Therefore, in sum, the position of this local stakeholder could best be described as a mixed one, drawing on both of the two paradigms.

To conclude this section, local stakeholders are a very heterogeneous group, and it is difficult to make any general claims about them. This section presented several examples in which people from the preselected municipalities relate to possible risk or uncertainty issues. Based on the knowledge of the controversy, these examples were selected as typical, although they certainly do not represent the whole scale of different perspectives. According to these examples, people at the preselected sites

often come close to the uncertainty-based paradigm in the sense that they articulate concerns whose outcome is difficult not only to predict, but also to categorise, or to advise specific management strategies for them. Vulnerability of the natural and social environment seems to be pointed to. But at the same time, local stakeholders in the examples sometimes assume a clear separation between expert and lay knowledge with delegation of technical issues to experts, and they expect the experts to provide clear answers on the technical issues, and show specific procedures and knowledge to handle the issues. To put it bluntly, they are not really ‘interested in the uncertainties’, but want to see that the experts can handle them. Such expectations can be seen as closer to the risk-based paradigm. Therefore, in the case of local stakeholders, rather than speaking either of risk-based or of uncertainty-based paradigm, the examples show their approach as a mixture of claims and expectations drawing on both of these paradigms.

Conclusions

The aim of this article was to contribute to understanding the recently failed dialogue about the Czech geological disposal for highly radioactive waste. Drawing on two strands of scholarship on risk and uncertainty, the risk governance school and the STS perspectives on sociotechnical controversies, two paradigms for dealing with risk and uncertainty were outlined. These were used as a framework to analyse how implementers and local stakeholders articulated possible risk or uncertainty issues in negotiations about the Czech geological disposal between 2009 and 2013.

The analysis by no means claims to be exhaustive. Only a few empirical examples were presented and analysed. In addition, the diversity of the actors involved in the controversy was crudely conflated into two groups. Nevertheless, these reductions were based on the author’s detailed knowledge of the controversy from previous research. The author believes that such research strategy is legitimate in the task of offering a new contribution to explaining the controversy, which can be further scrutinised, criticised and of course refuted.

The analysis showed that whereas the implementers adopt (sometimes even an extreme version of) the risk-based paradigm, the positions of the local stakeholders seem to be mixed, even within single utterances. The latter observation is contrary to what some STS literature suggests – that local stakeholders prefer the notion of uncertainty and the collective exploration of it. These observations lead to two conclusions: first, at the theoretical level, perhaps some of the STS literature was too quick to assume that people ‘want’ uncertainty. The present examples suggest that people want certainty, and that they set out to explore uncertainty primarily when they feel that experts have not done their work properly. Second, at the practical level, it is of course a question to what extent the positions of the local stakeholders are a matter of NIMBY-like efforts to refuse the repository at all costs. But nevertheless, given the fact that the dialogue failed, it might be worth for the implementers to try to go a few steps back, and consider the possibility that perhaps still much more work needs to be done in order to turn uncertainty into risk, in the first place being more sensitive to the uncertainties and concerns that local stakeholders articulate. Such approach may turn out to be not only more democratic, but also more feasible and ‘efficient’.

Acknowledgments

I would like to thank Marijke Hermans, Zdeněk Konopásek, Yannick Barthe and two anonymous reviewers for providing valuable comments on earlier drafts of this paper. I would also like to thank all partners within the InSOTEC project for discussions that inspired writing this paper.

Funding

The data presented in this article were collected as part of the InSOTEC project supported by the European Atomic Energy Community's Seventh Framework Programme (FP7/2007-2011) [grant number 269906], carried out at the Center for Theoretical Study, the Institute for Advanced Studies of the Charles University in Prague and the Academy of Sciences of the Czech Republic.

Notes

1. According to the Czech 'Atomic Act' passed in 1997, the state is responsible for radioactive waste management. The Act establishes the Radioactive Waste Repository Authority (SÚRAO) as an organisation implementing radioactive waste management policies. SÚRAO is subordinate to the Ministry of Industry and Trade. As will become apparent later in the text, at some moments of the negotiations, representatives of the Ministry came forward to speak instead of SÚRAO. Therefore, in this text the word 'implementers' is used to denote state authorities acting towards geological disposal implementation, where it makes no difference whether these are SÚRAO or the Ministry.
2. Moreover, scholars in science studies have introduced different variants of uncertainty, to account for its different possible 'degrees'. For instance Callon, Lascoumes, and Barthe (2009) speak of 'radical uncertainties', whereas Wynne (1992) speaks of 'ignorance' and 'indeterminacy' as different flavours of uncertainty.
3. At this point, the difference between the theoretical foundations of the two perspectives becomes apparent in the very notion of 'constructivism' – both of the paradigms have engaged with the issue of risk construction, but in completely different ways. Representatives of the risk-based paradigm have discussed the question whether risk is constructed or whether it is real, and they have arrived at the conclusion that it is both constructed and real, and therefore needs 'a dual strategy for risk management' (Klinke and Renn 2002, 1076). In contrast, in the uncertainty-based paradigm, the question whether risk constructed or real is irrelevant. Here, the important question is how it is constructed (de Vries, Verhoeven, and Boeckhout 2011, 490).
4. In a very similar manner, Callon, Lascoumes, and Barthe conclude that '[R]isk is that which remains to be discussed once the work of exploration of technical and political uncertainties has been taken to its end' (2009, 228).
5. The 2015 deadline was moved to 2018 by a governmental resolution passed on 20 December 2012.
6. The following development is described in more detail in Konopásek and Svačina (2014). For another overview, see Ďurďovič, Vajdová, and Bernardyová (2014).
7. This promise was voiced at many events (e.g. public debates in Věžná on 12 April 2012, in Blatno on 25 October 2012, a seminar in the Senate of the Czech parliament on 24 April 2012, or the OECD-NEA Forum for Stakeholder Confidence in Karlovy Vary on 25 October 2012), and became widely known among the stakeholders.
8. Public meetings in Bukov and Věžná, 7 and 9 January 2013.
9. Meeting of the Working group, 12 March 2013.
10. Cf. Barthe (2009) for a similar research strategy.
11. The same presentation was given during a number of other events, such as the Forum for Stakeholder Confidence in Karlovy Vary (24–26 October 2012).
12. The nuclear fund was established by the Atomic Act of 1997. It is established at the Czech National Bank, and supervised by the Ministry of Finance. All radioactive waste producers are obliged to contribute to this fund; the amount of the contributions was set

by a governmental decree in 2002, and has not been changed since then. The nuclear fund is supposed to pay for all radioactive waste management as well as for decommissioning of nuclear reactors; therefore, also the operation of SÚRAO is financed from the nuclear fund.

13. This is apparent for example from SÚRAO annual reports 2010–2013.
14. It can be observed that due to the hypothetical location, a Strategic environmental assessment report would be more appropriate here. Nevertheless, perhaps due to the Czech legislation at the time of publication, the report is written as an EIA report, despite the lack of any site-specific information.
15. This observation supports Wynne's argument that rather than 'embracing uncertainties', which is the conventional view, science in public 'gives prominence to a *restricted agenda of defined uncertainties*.' (Wynne 1992, 115).
16. Similar position has been characterised as that of 'technologies of hubris' (Jasanoff 2003).
17. Not only in the examples presented, but the author has not identified any such cases in the whole data-set.
18. It should be noted that trust in state institutions in the Czech Republic is very low, about 10% below the EU average (cf. e.g. Eurobarometer surveys available at http://ec.europa.eu/public_opinion/cf/index_en.cfm).
19. This article (Svejkovský 2012b) was probably written in response to an article called 'Geological research: One-kilometre-deep drill is a matter of routine' published in a SÚRAO leaflet (SÚRAO 2012).

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