International Socio-Technical Challenges for Geological Disposal (InSOTEC): Project Aims and Preliminary Results - 12236

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ABSTRACT

InSOTEC is a social sciences research project which aims to generate a better understanding of the complex interplay between the technical and the social in radioactive waste management and, in particular, in the design and implementation of geological disposal. It currently investigates and analyses the most striking socio-technical challenges to implementing geological disposal of radioactive waste in 14 national programs. A focus is put on situations and issues where the relationship between the technical and social components is still unstable, ambiguous and controversial, and where negotiations are taking place in terms of problem definitions and preferred solutions. Such negotiations can vary from relatively minor contestations, over mild commotion, to strong and open conflicts. Concrete examples of socio-technical challenges are: the question of siting, introducing the notion of reversibility / retrievability into the concept of geological disposal, or monitoring for confidence building. In a second stage the InSOTEC partners aim to develop a fine-grained understanding of how the technical and the social influence, shape, build upon each other in the case of radioactive waste management and the design and implementation of geological disposal. How are socio-technical combinations in this field translated and materialized into the solutions finally adopted? With what kinds of tools and instruments are they being integrated? Complementary to providing better theoretical insight into these socio-technical challenges/combinations, InSOTEC aims to provide concrete suggestions on how to address these within national and international contexts. To this end, InSOTEC will deliver insights into how mechanisms for interaction between the technical community and a broad range of socio-political actors could be developed.

INTRODUCTION

InSOTEC is a three-year collaborative social sciences research project funded under the European Atomic Energy Community's 7th Framework Programme FP7/2007-2011[1]. It aims to generate a better understanding of the complex interplay between the technical and the social in radioactive waste management and, in particular, in the design and implementation of geological disposal. Through this, the InSOTEC partners hope to create greater awareness among the technical community of the social implications of their work, as well as of the

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underlying social assumptions that directly and indirectly color the solutions they are developing. Meanwhile, the InSOTEC consortium hopes the project to be able to give other parties concerned (such as political decision makers or involved communities) a better insight into the origins of certain technical concepts, which may help them to be better equipped when dealing with these issues in their own context.

The InSOTEC partners view the technical and social challenges related to radioactive waste management as being intimately linked. As such, the concept of deep geological disposal is represented as being part of a social environment and therefore as being partially shaped by it. Key challenges for radioactive waste management are located at the intersection of generic, technical management concepts and the real world environment in which such concepts are to be implemented. While "safety first" is the ruling mantra for all concerned, from waste management agencies, over safety authorities to NGO's and affected communities, concerns and interpretations may vary among different groups, and solutions may vary between countries [1]. Monitoring programs, for example, although based on common principles, are likely to be affected by their national and local contexts. The question of waste transports is another example that reflects a combination of technical, environmental and social constraints. Establishing and maintaining a long-term sustainable relationship between the waste management system and its natural and social environment is a crucial condition for any long term management option to be able to address the fundamental principles of radioactive waste management as listed by the IAEA in 1995, in particular principles 4 and 5 on the protection of future generations and avoiding to put undue management burdens on them [2].

With this paper we would like to draw the attention of the different actors concerned with radioactive waste management to our work in progress and raise some initial food for thought. Additional information can be found on the project's website: www.insotec.eu.

ON INSOTEC

InSOTEC offers targeted social scientific research that addresses issues of a 'natural scientific' (the so called 'hard' sciences or 'beta' sciences) and technical and engineering issues associated with long term radioactive waste management in their interconnectedness to social aspects. The implementation of geological disposal is in that respect viewed as a possible means to attain a safe long term management of radioactive waste, rather than a goal in itself. The socio-technical challenges for implementing geological disposal will therefore be looked at within the broader context of how radioactive waste management strategies are defined (by technical experts and by society), and how geological disposal fits into these strategies.

Complementary to providing better theoretical insight in the complexities of radioactive waste management by describing them as socio-technical challenges, InSOTEC aims to provide concrete suggestions on how to address the actual socio-technical challenges identified within national and international contexts. To this end, InSOTEC will deliver insights into how mechanisms for interaction between the technical community and a broad range of socio-political actors could be developed.

InSOTEC project partners expect to offer support to scientists and technical experts by developing the tools (e.g. with regard to technology transfer and transfer of socio-technical innovations, the issue of reversibility, the inclusion of social aspects in the safety case model, …) and the ability to communicate in a two way process about their work and to engage with stakeholders on technical and safety issues.

The project will furthermore provide recommendations to the European Implementing Geological Disposal Technology Platform (IGD-TP). This technology platform was established in 2009 on the initiative of a number of European waste management agencies. European Technology Platforms (ETP) are a specific tool supported by the European Commission (EC) to bring together R&D-relevant stakeholders with various backgrounds, led by industry, to set a strategic research agenda and to develop a long-term R&D strategy and action plans in technological areas of interest to Europe [3]. Although most ETPs seek in one way or other connection to a broader range of stakeholders beyond the technical community in their particular field, there is no standardized approach to involve diverse stakeholder groups, nor are there specific instructions or expectations in this regard formulated by the EC [4]. The IGD-TP has a dedicated Exchange Forum (EF) through which it wants to interact with stakeholders. Up until now this Exchange Forum has mainly been able to attract specialized stakeholders from the technical research community. InSOTEC will investigate how stakeholders representing different parts of concerned society with different backgrounds could be linked to the platform's EF on a structured basis. In addition, advice will be provided on how to set priorities for a multidisciplinary research agenda which incorporates social sciences and which will address socio-technical challenges in a coherent and integrated way.

The InSOTEC Stakeholder Reflection Group - an advisory committee composed of nine individuals representing different groups interested in the subject (social scientists, implementers, local communities involved in radioactive waste management issues, national oversight bodies, the IGD-TP and the NEA) - is set up to ensure that different perspectives from potential end users are taken into account and that the results are useful to the 'practitioners' in the field.

ON SOCIO-TECHNICAL CHALLENGES

Within the InSOTEC project we look specifically for issues with regard to radioactive waste management that could be characterised as socio-technical in nature. Ultimately one could argue that anything technical is inherently social and that any given social issue can have some technical component to it. However, in many cases that relationship is stable, relatively unambiguous and not open to fundamental controversy. Today it would be hard to imagine a world without cars, microwaves or the internet, while less than 150 years ago, bicycles were considered a controversial technology and several different models competed for social approval [5]. And who still remembers the Betamax, now that it's conqueror VHS is on the verge of being mad extinct by the digital recorder? What we will focus on in this paper, are situations and issues where the relationship between the technical and social components is still unstable, ambiguous and controversial, and where negotiations are taking place in terms of problem definitions and preferred solutions. Such negotiations can vary from relatively minor contestations, over mild commotion, to strong and open conflicts.

Geological disposal is a particular technology to deal with the problem of radioactive waste; a technology that is considered by the expert community as the best available: *"The prevailing view of technical experts, as well as of many members of the general public that have been familiar with the work relating to geological disposal, is that geological disposal is a safe and technically achievable solution."* [6]. The recently adopted European Council Directive "Establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste" [7], takes this technical consensus as a basis: *"It is broadly accepted at the technical level that, at this time, deep geological disposal represents the safest and most sustainable option as the end point of the management of high-level waste and spend fuel considered as waste"* (consideration (23) framing the Directive). As a consequence it urges

Member States to develop and implement (by 2015) national programmes for the management of all spent fuel and radioactive waste under their jurisdiction, including disposal as the final stage in the management of radioactive materials (article 11 - §1). By treating this as a pressing issue, with clear deadlines, this new Directive suggests there is now at the European level also a political consensus that geological disposal is the technology of the future, where high level waste and spent fuel are concerned.

However, this does not mean that the technology is no longer controversial and that any potential negative consequences from this technology have been generally accepted as being outweighed by its potential benefits. Many of the general public, as well as many environmental groups and scientists from other disciplinary backgrounds, are still not convinced. The last Eurobarometer survey on attitudes towards radioactive waste for example showed that despite 43% of the Europeans polled thinking deep underground disposal to be the most appropriate solution for the long term management of high-level radioactive waste, still more than 70% of all respondents did not believe that there exists today a safe way of getting rid of it [8]. This may or may not have to do with the fact that few people are familiar with the concept of geological disposal and the research done so far in that field, as the above quote from the NEA - RWMC statement suggests. Still, doubt remains even among those more familiar with the work on geological disposal. In a review of scientific papers on geological disposal, commissioned by Greenpeace, Wallace (2010) stresses the remaining uncertainties and gaps in knowledge, for example on corrosion and chemical effects, and expresses concerns regarding the reliability of models predicting long term repository safety [9].

What is also clear, is that the concept of geological disposal has developed, and will continue to do so, not only because of evolutions in scientific knowledge, but also as a consequence of debates on how to integrate this technology into society. A clear example of this, is the introduction, by legal obligation, of the seemingly contradictory notion of reversibility into the concept of geological disposal in Switzerland [10] and France [11]. The reversible concept of geological disposal that is being developed in these and other countries today still has to prove its capacity for resolving competing values with regard to the safe disposal of radioactive waste. But it does show that we need to think about geological disposal (or more generally any technique to provide in the long term management of high level waste or spent fuel) not as a technology designed by scientists and experts, but as a socio-technical system of which the meaning and characteristics are negotiated and value laden.

RESEARCH WORK SO FAR

WP1 - Drawing boundaries: what do we define as socio-technical challenges ?

In its first phase the research is focused on identifying the most striking socio-technical challenges to implementing geological disposal of radioactive waste in 14 national programs (Belgium, Canada, the Czech Republic, Finland, France, Germany, Hungary, the Netherlands, Slovenia, Spain, Sweden, Switzerland, the UK and the USA). This overview of challenges characterized by a (potential) interaction between techno-scientific and socio-political aspects will be based on three main sources: (a) review of public documents; (b) exchanges with key actors and groups of different types; and (c) a review of social science studies on radioactive waste management and related topics, conducted in each country, identifying prominent research initiatives, topics and trends in the last two decades.

For each country the following elements are currently identified: (a) key events or developments; (b) main actors; (c) issues that have received the most attention and which may have changed over time (e.g. technical options, siting, reversibility and retrievability, monitoring, institutional control, participation, the so-called 'dual use' of radioactive materials in weapons and associated security questions of safeguards against their potential misuse, …). In each case an outline of the trajectory (e.g. policy developments or conflicts, innovations, adaptations and other types of change, whether of a scientific, technical, political, social or economic nature) that has led to the current state of affairs assists to set the situation in context and provide a clearer basis for comparative, cross-national interpretation.

A comparative analysis is currently being made of issues identified in the different countries, complemented with an analysis of how these issues have so far been treated in relevant international platforms. The analysis focuses on the interplay between socio-political and techno-scientific aspects of radioactive waste management; in particular, of geological disposal. It explores how to integrate what have been referred to as 'societal boundary conditions' (including, for example, public concerns or political and economic constraints) with the scientific, technical, environmental and regulatory boundary conditions for geological disposal facility design.

WP2 - Understanding socio-technical combinations: further analysis of specific topics

This part of the research in particular aims at developing a fine-grained understanding of the relationships between social challenges and technical challenges. How are social and technical challenges linked within radioactive waste management? How does the technical and the social influence, shape, build upon each other? How are socio-technical combinations translated and materialized into the solutions finally adopted? With what kinds of tools and instruments are they being integrated?

In order to examine these questions, a number of small case studies will be carried out, allowing us to describe and analyze what we call "socio-technical combinations" in the field of the management of nuclear waste. The main rationale for selecting the case studies is to concentrate on a few ones (three to four) and to do "problem related research studies". That is, "problem driven" cases in which the combination of the social and technical is both an issue/problem for the various actors and stakeholders involved and theoretically interesting because these cases shed light on the various ways in which social and technical challenges are entangled. A synthesis of the various case studies will then be made.

The change in wording from "challenges" in WP1 to "combination" in WP2 is subtle, but of importance. As will be further explained below, the social and the technical come together: the "social" (whether political preferences, public concerns, social values, national traditions, assumptions about future generations, decision making processes, …) are inevitably linked to techno-scientific issues (i.e. the kind of waste stored, the geological characteristics of the disposal site, the physical properties of containers for storage, (tools for) measurements, …). In discussions and debates about radioactive waste management what we see therefore is that scientific, technical, social, political issues are concurrently negotiated, pondered, and assessed. What will be investigated in this work package is whether various combinations are to be encountered. Potentially, "combinations" come in various guises depending on the country, the actors involved, the trajectory of the problem, the issues at stake, the protests previously organized, etc.

The methodology for carrying out the case studies is derived from a Science and Technology Studies (STS) approach. The notion of socio-technical combination lies at the heart of most STS work. Callon and Law (1989) initially argued: *"whenever we look at social action we discover a* *degree of innovation—that is, we find new sociotechnical combinations being assembled and imposed (or failing to be imposed) on others"* [12]. Actions and decisions take place within hybrid collectives, that is, combinations of what we usually call the social (human actors, relationships, norms, groups, values, etc.) and things deemed technical (technical equipment, measures, calculations, tools, texts, etc.). When we look at the making and design of aircrafts, bicycles, ships, buildings, nuclear reactors, light bulbs, diesel motors, or bridges, what we see is that beyond what might look like mere technical questions lie assemblages of humans and non-humans, subjects and objects, the social and the technical. In this sense, “artifacts have politics” [13]: artifacts embody political visions of society and, at the same time, they have consequences upon the ways in which humans relate to each other and to their environment. Just think of recent discussions about photovoltaic energy, about Japan’s decision to raise the limit of “acceptable” radioactive radiance for humans near Fukushima, or about European standards for mobile phones.

In this connection, STS rethinks the relationship between scientific knowledge and technological artifacts on the one hand, and social interests on the other. Callon and Law (1982) argue that social interests shape the production of scientific knowledge and technological artifacts, but this is not done in a unidirectional way [14]. The production of knowledge and technological artifacts also means the change of interests. When actors modify and translate their interests they simultaneously modify and translate the knowledge and technological artifacts they use, develop and believe in, as well as their identities as actors. This implies that technological innovation is not only about “the technical” but also about social interests, and identities of involved actors. This is a reason to talk about socio-technical combinations instead of technical aspects on the one side and social aspects on the other, or even worse: about a technical “content” surrounded by a social “context”.

Technological innovation also means innovation of identities, social roles, decision-making processes, and institutions that are adapted to the technological object as such. What goes on in an innovation process is mutual adaptation between many factors gathered together in one and the same process, where involved actors - whether they are called engineers, politicians or engaged citizens - do not separate between what is usually defined as technical and social factors. On the contrary, they know that they have to include both technical and social aspects in order to be successful.

FURTHER FOOD FOR THOUGHT

In today’s discussion on radioactive waste management a strong social and technical divide seems to be taken for granted. The focus of social issues is mainly placed on activities concerning public participation, with regard to actors and processes. Who should have the right to participate, and where and how to participate? More seldom the issue is in focus: on what to participate about?

If we look into what these issues are about, as for instance “geological disposal”, or “safe disposal”, of nuclear waste, we recognize that social and technical factors are inseparable. To design and decide on a repository for radioactive waste management is a task that is simultaneously technical and social. In this work we never find ‘pure’ technical or ‘pure’ social factors. However, we find people called engineers, as well as politicians and citizens. But this does not mean that the former know nothing about social aspects or that the latter groups do not possess technical knowledge.

Instead of asking about social factors we should ask about 'socio-technical combinations': a complex mix of different factors making up the process of nuclear waste management. We can be sure that engineers do not restrict themselves to so-called technical factors. However, sometimes, not to say quite often, activities are presented as being of a pure kind, for instance when nuclear waste companies present studies of bedrock conditions as if these are just about geology and not at all about public acceptance of a waste repository. But this is not how actors work in practice. The objective should therefore be to study how the mixing of technical and social factors is made up in practice, i.e. in socio-technical combinations.

This implies that projects like geological storage of radioactive waste should be understood as building socio-technical combinations. What we should avoid is therefore both a social and a technological reductionism, but also an interactional understanding, in which the social and the technical are evolving in isolated processes but subsequently interact [15].

We would therefore like to urge anyone concerned in this matter (the "technical community", policy-makers, NGOs, affected communities, concerned citizens, …) to think about radioactive waste management in an integrated way, rather than in terms of "objective" technical solutions and "value laden" compensation measurements to ease acceptance. For one, because thinking in a technologically deterministic/simplistic way is less democratic, will provide less robust solutions and lead to stronger oppositions. Why? Because it leaves out half the story, risks leading to lock-ins and a blindness to social and cultural consequences. But in order to arrive at more robust solutions, other actors outside the nuclear technical community must also be willing to take a broader approach, develop an active interest in the core of the problem and its potential (technical) solutions.

Such implies an active open policy, not only on the part of radioactive waste managers, but also of regulatory authorities, administrations and policy makers. Too often in the past, political decision-makers all over the world have left it to the waste managers and their technical partners to continue (generic) research in a confined environment, keeping the issue well clear of the political agenda and hence avoiding any fundamental societal debate up until the point when the question of siting emerges. In a European context, the recent EC Directive [7] mentioned before, and in particular its art. 10 on transparency[2], could in that respect be a leverage for countries to organize a more fundamental discussion on how to proceed with radioactive waste management, the role of geological disposal in that context and the consequences of considering – or not – alternatives. But this only provided that the Directive is interpreted in the broadest possible sense, with ample opportunities to debate the different steps in the nuclear fuel cycle - and their interconnectedness -, and that all relevant authorities and decision-makers take up their responsibilities in organizing such debate and responding to its outcome.

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