Abstract

Denmark is in a state of indecision regarding how to deal with its nuclear waste problem. There are currently two proposed solutions. A final repository by the government, and an intermediate storage solution by the public. The negotiations between these two actors have no common ground in sight, and a consensus between them seems impossible.

The purpose of this master thesis is to uncover the motives that have lead to this situation, and these two proposed solutions. It does so by applying Callon's concept of translation, to investigate how these two actors have problematized the Danish nuclear waste problem. To further investigate and evaluate these motives, we have chosen to include Mol's concepts of options, sites and interferences. These concepts have allowed us to analyse the motives in a structured way, which have lead to the discovery of a way to potentially resume the negotiations between the government and the public. Article 21 of the EURATOM directives requires Member States to dispose of low to medium level waste with a specific solution - a surface-near final repository. And the public is adamantly against any solution that will deposit the waste beneath the surface. However, considering article 24 of the EURATOM directives, there may be a way to undo article 21. But it requires the Member State to be able to demonstrate that an underground repository will put undue burden on future generations. This may then allow the government to investigate above ground repositories, which will create a common ground with the public.

We conclude that, even though our plan is full of ifs and mays, then it might be enough for the public and the government to begin a joint collaboration with the purpose of finding a solution they can both consent to.

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We hope that they find our interpretations and representations of the many sides and facets of this case to be somewhat accurate. If not, any errors are ours and should not be held against the mentioned persons.

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Introduction

Apparently, Denmark has quite a problem figuring out what to do with its nuclear waste. We had read a little about it in the news, but we had no idea the magnitude of this problem. It was not until we met Kristoffer Brix Bertelsen (in the role of our censor on our last project, no less) that we learned more about the issue, and how there was little chance of reconciliation between the government and the public. Without a reconciliation, there would be no solution. We were intrigued, and Kristoffer had an important role in the matter (we did not realise just how important it was at the time, however). And through the years of studying technoanthropology, we had learned never to miss the opportunity of great access to, well, any field.

So we set out to investigate the matter, in the classic technoanthropological manner. Which is to let the field tell us what to focus on, another thing we had learned through the years. We obviously had a few ideas, as in which theories to consider and what aspects of the problem that might be interesting, but most of all, we let the field guide the way.

The field continuously told us to focus on the public and their involvement in matter of nuclear waste disposal. Everything we read screamed at us to investigate the dynamics of the public actors. Every piece of text we could find in regard to other nations' experience with disposing of nuclear waste were focused on issues of the public.

Our next course of action was to try to demarcate our scope of interest. We kept trying and trying, but we were unable to make any sensible demarcation that would allow us to stay relatively true to reality, to portray the situation as we observed it. Up until we were recommended by our supervisor, to use Callon's concept of translation.

Slowly we were able to tame the beast of the Danish nuclear waste problem, in a way that let us reflect reality to a satisfactory degree. We were able to limit the scope to two actors in an intense tug-of-war about which solution should "dispose" of the nuclear waste, the government and the public (well, variations of these, which we will describe in the analysis). We even began to attain a considerable overview of the 17 year long process, by following the translations of the government and the public. Eventually we had described their respective problematizations.

The solution based on the government's problematization lead to a final repository. An underground facility, that should safely store the radioactive waste until the end of its decay period. The public's problematization lead to an intermediate storage solution. A facility above ground that will allow visitors to enter and to observe the waste and thereby confirming that it is safely stored.

But we wanted to know more. What were the reasons that these actors were so set in their choice of solution? Would it be possible that there were other solutions, that would fit their problematizations?

Literature review

Globally, challenges in implementing final repositories for nuclear waste, is the rule rather than the exception. We present an overview of selected studies attaining to the challenges of citizen involvement in nuclear waste handling processes. We have investigated these to provide us with a better understanding of the mechanisms others have identified as important in constituting final repository implementation as challenging.

In a paper by Judy Treichel (2000), it is described how historical events can be a determining factor for contemporary relations between, on one side, the government and experts, and on the other side, citizens of the public. The article is about an attempt made by the US government to dispose of nuclear waste at Yucca Mountain, Nevada. An attempt unsuccessful due to massive public resistance. She criticizes a decision-making process without any public involvement, and finally suggests that the native citizens of Nevada are the main cause of the project's demise. Citizens that previously had been subject to a government's risk perceptions on nuclear weapon testing (by convincing the public that the fallout as a result of the weapons testing was not dangerous). Perceptions that *time* had proved to be wrong. In the end, actions of the past had become a determining factor in regard to the citizens of Nevada's refusal to any future plans, which made a negotiation about risk and safety between the government and the citizens of Nevada an impossible task.

Another study examines the nature of citizens as an actor in nuclear waste disposal processes. It investigates whether the nature of the citizens should be reduced to a Nimby definition¹. They conclude that citizens involved in nuclear waste issues, cannot be reduced to Nimby, since: Their engagement often concerns a wider scope of issues, than just having it build in near proximity. They are well-informed and able to discuss an array of highly technical issues. Their commitment and arguments are generally not based on emotions. And even though the majority of engaged citizens

¹ "A person who objects to the siting of something perceived as unpleasant or hazardous in their own neighborhood, especially while raising no such objections to similar developments elsewhere." (Oxford, 2017) Another more journalistic description is made by Glaberson (1998): "Nimbys are noisy. Nimbys are powerful. Nimbys are everywhere. Nimbys are people who live near enough to corporate or government projects - and are upset enough about them - to work to stop, stall or shrink them. Nimbys organize, march, sue and petition to block the developments they think are threatening them."

Citizens characterized as being engaged as Nimbys can be described through their: Distrust in governments and other project proponents. Limited information about the problem and the risk. Parochial and localized view of the problem, risk and costs. Emotional assessment of siting proposals and, a generalized and particular risk aversion. (Clary & Kraft, 1991, pp 302)

were of near proximity to proposed repositories, they did not display a parochial outlook on the situation. (Clary & Kraft, 1991)

In a Korean study, it is described how the Korean government, through several attempts have failed to find an acceptable site for a repository. Each time attempts have been made, the public objected, sometimes violently, causing the siting process to be cancelled. Through an analysis of each step towards finding a possible location, Choi (2005) explains how the government's strategy was changed to adapt to previous causes for process failures. In the end, the public is identified as an actor, who, without exception, is going to object a repository siting in its near proximity. To overcome this challenge, it is argued that compensation to a selected community would be the solution that could enable public acceptance. (Choi, 2005)

In another category, several studies focus on the importance of public involvement and the methods that should be implemented to incorporate the public in plans of nuclear waste disposal.

A Swedish paper stresses that citizens are not easy to actively engage, and that they must see their involvement in a concrete way. Therefore, it is important to identify possible repository solutions, locations and areas for preparatory drilling programmes etc. *"When this has been done, the prerequisites for public involvement are expected to increase dramatically."* (Åhagen et al, 1999, pp. 375-376)

Another study from Sweden suggests that the public often have been disregarded in favor of "sound scientific evidence" in political decision-making. Any obstinance displayed by the public is attributed to images of fear, stereotypes & beliefs. A perception they do not agree with. To accommodate the public as a valuable actor, they propose a transparency forum to ensure that policy makers have the best possible knowledge to base their decisions upon. (Westerlind & Andersson, 2005)

IAEA also stresses the importance of the public involvement in decision-making; *"public involvement in the overall process can be crucial in developing confidence and trust, without which progress can be difficult if not impossible."* (IAEA, 2011)

Context

Based on this review we now turn our focus to the Danish situation. A situation where stakeholder involvement has interfered and complicated the process of establishing a final repository for the Danish nuclear waste. And like we mentioned in the introduction, the current stalemate is characterized by two separate central actors, each pushing for their own version of a solution to the problem.

What we then wish to investigate, is the causal links that complicated the Danish situation and created the mentioned stalemate between two different solutions. Is it actions of the past that has shaped stakeholders as opposition to experts and the government? Is it the fear of having a nuclear waste repository in one's backyard? Is it lack of compensation to potential repository sites? Or has the involvement process just not been conducted in a constructive manner? Could there be other reasons? Probably. And this is what we have set out to investigate.

Research Question

To sum up, we can now define our problem as:

The government and the public have not been able to establish consensus on deciding on a specific solution to the Danish nuclear waste problem.

To attend to this problem, we put forward the following as our main research question:

Why has the public and the government not been able to establish consensus on deciding on a <u>specific solution?</u>

Theoretical Background

As Techno-Anthropologists, we are interested in how technologies shape, and are shaped by us and the world we live in. In this report, the subject matter is nuclear waste, and the controversy we are engaged in, is the handling of the nuclear waste in Denmark. In this controversy, various versions of solutions are brought forward by experts, government officials, NGOs and citizens. Ultimately, a political decision will ratify *a* version of the question of *how nuclear waste should be handled in Denmark*.

As mentioned earlier, decisions about the topic of nuclear waste handling often results in difficulties transitioning political decisions into practical actions. It is within this sphere of deciding on "good" solutions to problems, that we wish to contribute. We do this by applying methods of inquiry and analysis from the fields of ethnography and anthropology to investigate the relations that constitute these solutions as meaningful, i.e. how each one, if framed in a certain way, makes perfectly good sense as a "good" solution, and at the same time, if framed differently, can seem as a wrong choice.

At this point it might be vague what our subject of study is. Is it about finding a "good" solution to the problem? Probably not, but maybe it will create grounds for talking about a "good" solution in this specific context and time. But then again, is a "good" solution one that minimizes negative political exposure? Will "good" be determined by economic measures? Or will it be a matter of pure technical predictions on safety? Maybe just a solution that is not within close proximity of the area a specific person lives in? It should become clear, that what we are trying to do here; is to problematize the notion of "good", which implies that some way is better than other ways, which is plausible, but it becomes a matter of interpretation. And this is the subject of this study; to research and describe how different versions of solutions are established as meaningful in specific contexts and then again made meaningless in others - ultimately creating a field with many different solutions framed as "good" solutions, all proposed by different networks of actors, whom each brings their own ontological arenas for judgement of right and wrong choices as to the challenge of handling the nuclear waste.

The report aims to research a controversy between these different versions of solutions and show how *one* solution might have made sense for several years, but then suddenly, becomes deprived of the ontological arena of which it made sense in, and instead gets displaced into a controversy where it is not the only solution, and the arena of judgement is no longer characterized by homogeneity, but instead, a heterogeneous nightmare, where distinguishing between good and bad, becomes a matter of point of view. Therefore, we have chosen to include Annemarie Mol's concepts of *options, sites and interference*. But before we get into the that, we must go through our overall theoretical

framework, which we have shaped to be a prerequisite to Mol's concepts within decision-making arenas.

Actor-Network-Theory

We will explore this controversy by delving into the nature of different solutions based on overall inspiration from *Actor-Network-Theory*. *ANT* was developed by Bruno Latour, John Law & Michel Callon i.a. and emerged as a response to the practical implications of poststructuralism by asserting ways to see and explain what is studied. (Law, 2009, pp. 146)

To elaborate on characteristics of ANT; calling it a theory might be counterproductive, since the word theory might imply some sort of structuralism with preconceived conditions about the way the world works. Instead John Law, an important contributor to the development of ANT, suggests that "...*It is better to talk of "material semiotics" rather than "actor network theory"*. (Law, 2009, pp. 142) Since what it is about, he argues," *...is a sensibility to the messy practices of relationality and materiality of the world"* (ibid). Or maybe it is a theory, if a theory is framed in a certain way, as Bruno Latour puts it; "...*It's a theory, and a strong one I think, but about how to study things, or rather how not to study them—or rather, how to let the actors have some room to express themselves"* (Latour, 2005, pp. 142).

Translated into our research, this means, that when entering the field searching for empirical data, we do not hold preconceived notions about any underlying reasoning for actors telling about their opinions, referring to certain documents, or in any way enacting the situation seen from their perspective. Instead, we seek to understand and describe their perspectives by unfolding what we find to be the conditioning for their enactments of the subjects at hand. Explained in another way, using a metaphor from Law, what we see in practice is *"…a continuously generated effect of the webs of relations within which they are located."* (Law, 2009, pp. 141). It is from these *webs of relations*, that we set out to understand and describe the different versions of solutions to the Danish nuclear waste problem. To exemplify; if one actor in our research frames a certain solution as a bad idea, and then again, another solution as a good idea - then what we wish to unfold, is the web of relations that constitutes either one as good or bad.

About actors

When talking about actors within the ANT framework, we are referring to entities who perform actions or, in any way influence others in the situation we are observing. In other words, an actor is something which can *"exert detectable influence on others"* (Law, 1987, pp. 132). The term actor is

not limited to humans, but is guarded by the principle of generalized symmetry which entails that both human and non-human actors can have equal influence on a situation, and therefore, should receive the same analytical attention and same vocabulary when being described (Law, 1992) (Callon, 1986).

In our case, this means that nuclear waste, economics, technologies, organizations, humans, etc. all have the potential to become an actor in our research. The only requirement is, that we observe and choose to include their influence on the situation we are describing.

About actor-networks

Whilst actors are single entities, actor-networks (or just networks) consist of groups of actors who together has joined forces in supporting or producing an influence that can be observed. (Law, 1992)

For an actor-network to emerge, there will be an observable negotiation between different actors, where one or more will inhabit the role of the controlling actor, whose role is attempting to enrol other actors to create a strong network supporting their objectives.

If an actor succeeds in enrolling other actors and creating that strong network, then the network has moved towards a more stabilized, and in ANT vocabulary, punctualized stage, where the initial controlling actor, and others for that matter, can begin to act and perform influences on situations as representations of a network (actor-network), instead of a single entity².(ibid. pp. 385)

Once an actor-network has been punctualized, it is no promise that it will remain of that nature. As Law puts it when talking about a punctualized network: *"It is that something much simpler* [...] *comes, for a time, to mask the networks that produce it"* (ibid, pp. 385) referring to the precarious nature of actor-networks. For while it may be characterized as punctualized, it is always subject to change.

For instance; if a network consisting of three actors has been punctualized and together represent network X. Then one of the three actors, actor Y, becomes enrolled in another network, which influences actor Y to no longer be able fit into the current configuration of network X. Then network

² Getting down to the nitty-gritty, calling an actor a single entity may be wrong. Since all actors have emerged through negotiations and interactions with other actors(-networks), and in the overall sense, always will represent a actor-network. For instance, whilst a person we present as *an* actor may influence the situation based on, what seems to be, their own representation of the situation. Then, that person still represents a network in the overall sense - that person is often embedded in a culture where values, norms etc. can be included as influential to what we observe as a single entity (actor), influencing the situation. And this is ANT in a nutshell; it does not create boundaries for what is important to include in representations, thus leaving us with the possibility to keep digging until what we are doing may have lost all sense of meaning. Therefore, it is important to make distinctions between actors and networks in our version of what we are studying - it enable us to describe and present what we find important. Sometimes limiting in ANT sense, but also a necessity when working with ANT.

X, becomes weakened by the absence of actor Y, and therefore no longer represents punctualized network.

But this does not mean that network X has vanished. If an actor now again attempts to enrol actor Y into network X, then new negotiations might have to take place to make actor Y enrol once again. And if it is successful, network X is once again punctualized, but as something that has adapted to become a new punctualized version of network X. The process of shaping and success or failure of actor-networks is in ANT vocabulary called *translation*.

About translations

Throughout our entire analysis, we have taken inspiration from Michel Callon's (1986) article *"Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay"*. At the time of this article, ANT had not yet been described as a theory, but a specific notion in this article marks the beginning of a central concept within ANT. That of *translation*.

The concept of *translation* is presented as a "*new approach to the study of power*" (ibid. abstract), which aims to describe how a central actor attempts to domesticate other actors into sharing a common objective, i.e. creating a strong network.

To describe the mechanics within a translation, Callon uses *the four moments of translation:* problematization, interessement, enrolment and mobilization (ibid.). In his article, Callon is applying the concept on a situation involving four different actors; the three researchers (in the role of the central and domesticating actor), and the scallops, the fishermen and the scientific colleagues as the subset of actors that must be aligned with the goal of the researchers.

Problematization

The first phase described, problematization, consists of the central actor defining their study goals and identifying which other actors that are related to achieving their study goal, as well as their interests. Once the other actors have been identified, the central actor can begin communicating a version of the situation that includes their representation of the other actors and their interests related to the study goal.

In Callons article, the study goal is built upon three researchers visiting to Japan, where they have seen a specific species of scallops cultivated for food production. They wish to see if the methods used in Japan, also would be applicable to the scallops native to the waters of St. Brieuc bay in France. The researchers define their own interest in the subject as their opportunity to contribute to scientific knowledge about early life of scallops. In their problematization of the related actors, the fishermen are described as aware of a situation where the only way to secure a long-term source of income, is if they share the goal of the researchers. The scallops are described as an entity, which only way of proliferation and survival relies on their enrolment in the researcher's study goal. The scientific colleagues are described as an actor that does not have knowledge to answer the questions the researchers are asking, and therefore they are interested in enrolling into the researcher's study goals to advance knowledge on the field.

Finally, in the phase of problematization, the researchers identify what Callon calls an *obligatory passage point*, which is a question that all entities are fettered to. The question in Callons article is; do the scallops anchor? - For the scallops to survive, for the fishermen to attain long term economic security and for the scientific colleagues to advance knowledge, they all need this question answered.

At this point, all actors have been identified, described and linked to an obligatory passage point that, if answered, solve the problems for all involved actors. Thus, the phase of problematization.

In our case, we see the problematization phase as initially carried out by the government and its associated experts in between 2001 and 2003. Where they evaluated the task of handling the Danish nuclear waste and ultimately proposed future actions in a political motion in 2003(B48 ref). Furthermore, we see the phase of problematization as a recurring event through the process that has been going on, and therefore, the notions of problematization will not only be linked to the specific point in time between 2001 and 2003. The concept will be applied to understand every time a central actor defines or redefines a problematization towards the question of handling the Danish nuclear waste throughout the entire process.

Interessement

The next phase described by Callon is interessement, which involve a strengthening of the different actors' connection to the study goals of achieving the obligatory passage point. This is again done by the central actor, who attempts to impose and stabilise the identity of the other actors that are being described through problematization.

To explain this concept using an example from Callon; we have to understand that while we perceive the situation from the point of view of our central actor. Then, there are still other actors who, on their own, tries to define the identity of the same actors that are being described in the three researchers problematization. For example, there are different predators, for whom the situation is different. For them, the scallops, or larvae, before they can be called scallops, are food. They are not

interested in enrolling into the obligatory passage point of finding out whether the scallops anchor themselves, they are interested in eating anything available to them. And if this is the situation, that A, the researchers, wish for the scallops to anchor, and B, the scallops, wish to survive. Then having C, the predators, as an actor in the equation of solving the obligatory passage point, is not beneficial for A, the researchers. Therefore, A, the researchers, attempts to interesse the B, the scallops, by inserting an interessement device; a net to keep out C, the predators, and thereby removing them from B, the scallops, connection to A, the researchers and their study goals.

In our case, interessement mostly involves research and documentation of identified entities. What we mean by this, is that the entities that we have seen identified through problematization, often comes in a shape of many unknowns (thus also the recurrence of problematization). An example is the geology of Denmark, which is an important factor in determining a solution. But whilst being important, it still needs to be researched and described before it will have impact on a physical solution. This is something the government and the experts are aware of, and therefore, in conjunction with identifying and problematizing the Danish geology, they also identify the need for an interessement device, that can transform the geology into numbers and facts that are applicable in a situation where a solution shall be determined.

Enrolment

Described as the outcome of successful interessement, enrolment is the point in the translation, where the central actor can define an actor's relation to the obligatory passage point as aligned with the objective of the study. I.e. a move towards a punctualized actor-network.

In Callon's article, the scallops are enrolled at the moment when, it can be undisputedly declared that, they do in fact anchor themselves to the materials placed for their cultivation. Something that is not certain beforehand, but is achieved through a negotiation between the researchers and the scallops, where to several interessement devices are deployed to strengthen the scallops connection and likelihood of anchoring to the materials. Different anchoring materials are tested, predators are locked out through the use of nets, materials are placed where current are the weakest. In the end, the scallops anchor to the materials, and are thereby enrolled.

Another example from the article is the scientific colleagues, whom, did not need the same extent of negotiation before they were considered as enrolled. Initially, it had been agreed between the scientific colleagues and the researchers, that no prior knowledge existed on scallops ability to anchor themselves. But when the researchers presented their data, which showed that scallops did anchor on certain materials - the scientific colleagues proposed conditions to the validity of the

results: Prior knowledge about scallops ability to anchor should be recognized, and existing numeral data should function as validation of whether the scallops were able to anchor or not. As long as the researchers could provide data corresponding to prior knowledge of scallops anchoring, the scientific colleagues were enrolled into supporting the study.

The last actor, the fishermen, did not need any negotiation to become enrolled as such. They were seen as silent bystanders as per their desire of long-term economic solution, just waiting for the researcher's judgement on whether or not the scallops anchored.

At this point, all entities have become allies and enrolled into the study. The scallops have been negotiated into anchoring by means of interessement devices, the scientific colleagues believe in the fact that scallops do anchor themselves, the fishermen are enrolled because they have been persuaded into the need for scallops to anchor to secure their future income. Their positions are now fixed, and their relations have been negotiated and defined. They are enrolled.

In our research this means for example, that when the physical nuclear waste is identified as an actor that inherits certain properties such as, being complex and only partially defined. Then the enrolment we describe, is when that actor, for example, instead of being complex, becomes a certainty that supports a specific solution.

Mobilisation

"Who speaks in the name of whom? Who represents whom? These crucial questions must be answered if the project led by the researchers is to succeed." (Callon, 1986 pp. 208).

Often, during a translation, some actors will be representing more than just themselves. An example is the fishermen, whom are represented in the researcher's version of the situation by a few elected representatives, these then serve as spokespersons for the entire fishing community in St. Brieuc Bay. Through statements and agreements made by the representatives, the fishermen have been condensed into a mobilised version of the fishermen, thus transforming a complex network of actors into something more manageable. An entity that can be negotiated with.

As for the scallops, or larvae, which exist in large numbers. They become deduced into the specimens that choose to anchor to the materials, and the rest, all of whom which did not anchor, still received a label confirming their ability to anchor.

The scientific colleagues, who bought into the statement that the scallops did in fact anchor, also represented a mobilised version of a scientific community in which consensus was sought. The

defined actor "scientific colleagues", consisted of the ones who had read their publications and attended a conference, and exclude those who did not.

But as shown in Callon's article, the process of translation is never finished, and as quickly as it became established as a successful translation, it dissolved into fragments without coherence.

The fishermen decided to fish the waters for immediate economic return, thus betraying the mobilized version of the fishermen that had agreed not to. The scallops' ability to anchor decreased, and all the scallops that previously had not anchored, now became "the scallops" acting in the translation. So even though a *"constraining network of relationships has been built[…] consensus and the alliances which it implies can be contested at any moment. Translation becomes treason."* (Callon, 1986, pp. 211)

Returning to our project, what we have seen, is different actor networks, each attempting to control a translation towards a "good" solution to the nuclear waste problem. And to understand the development, successes and demises of these translations, we see Callon's four phases of describing the sociomaterial mechanisms in translations as a suitable tool to gaining a deeper understanding of our field.

Options

As we are going to depict in our analysis, a coherent and unified translation towards handling the Danish nuclear waste has not yet been achieved by all actors involved. And as our contribution to the issue of finding a "good" solution, we will conclude our analysis with a presentation of what we have identified as "clashing points", that separates one translation from unifying with the other. It is our hope that an explication of challenges and their inherent nature, will contribute to a more fruitful translation in the future.

To do this, we will use the concept of *options* as put forth by Annemarie Mol (1999) as a way of thinking about situations in which there are several choices and decision have to be made. It takes the form of apparent entities, available as present singularities that can be separated, viewed, evaluated and chosen, instead of others. The reason for forming *options* as a concept is for it to function as a means of making an example, exploration and explanation of why choice and decision-making maybe should be thought of in a different manner. This is done in an effort to contribute to how we might better understand the dynamics of decision-making. It serves the purpose of turning *realities* into a concept (*options*), that then more smoothly can be used in discussing situations of choices and how to think of making them. It builds on the ontological understanding of ANT and the view of how *reality* and *things* are constructed.

To address this way of thinking, *Option*, as a seemingly singular entity, is introduced to the rather complex view on reality presented by ANT (as described through the ontological idea of ANT, reality must be thought of as multiple, coexisting versions). To create a common ground (and to be able to begin a discussion at some kind of starting- or entry-point, which ANT is not necessarily the best at doing or pointing out), these entities (*options*), may be thought of as a manifestation of the apparent specification of a *reality's* concrete performance. Thereby turning them into more manageable entities than ANT may suggest them to be. In doing so, we have now begun applying the ontological understanding of ANT into this way of viewing choice.

To help make the exemplification clearer as to why this approach to choice is problematic, we accept (at least temporarily) the idea that choice is composed of *options*. However, if this is the case, the next question in line would be, what then, are the *options* composed of?

According to Mol, these *options* themselves cannot be singular, but are (as everything else) always constructed and enacted in relation to other actors. This means that the seemingly palpable dynamics of choice and its *options*, is more complex than it seemed at first glance. Now, if presented with the choice between two *options*, we must break down each of them into the fragments from which they are constructed, if we are to conduct an evaluation. The underlying reasoning of the *options* construction, what within ANT terms often is referred to as *relations*, now comes forth as the basis from which our evaluation should be made. This new dynamic may therefore cause the actual relevant site for evaluation (assuming that this can still be done) to shift onto other places than originally assumed. What was previously viewed as two (or perhaps more) *options*, multiplies as there may be many relevant reasons (relations) influencing the original *options* construction (the *options' options*, if you will).

In situations of choice, it seems that certain structures with an emphasis on resolving processes of decision-making and discrepancy exists. Such dynamics of discussion, argumentation and evaluation on behalf of the available *options* can be problematic since arguments drawn from these may have been originally enacted, not for the purpose of comparative argumentation, but under very different circumstances. In such cases, meaning are at risk of being lost, since it might not necessarily translate well into other environments from which it was not originally constructed.

Mol asks "Where are the options?", to which one simple answer in this case could be, "elsewhere".

"For it might happen that arguments that are mobilized in decision making shift the 'real' options to other sites, and then on again to further and more distant locations. That there is no last resort but

instead there are 'options' everywhere. So, that at any given site, they always end up seeming elsewhere."

(Mol, 1999, pp. 80)

As a result of focusing on the underlying reasoning as newly established *options* (the *option's options*), we encounter a different challenge. As we have now slightly decentred the attention away from the situation of choice and onto the *option's* construction, what we find is differently situated. What constructs these *options* are not (necessarily) related to the situation in which a choice has to be made, but rather it is shaped as the elements that makes and gives meaning to that specific *option*. Its bearing pillars, if you will. Any *option*, if seen from that specific point of view, will now seem not as a matter of choice or as a matter of deciding between *options*. Instead, what we find are meaningful reasons and relations as logical facts that expresses why that specific *option*, is the right way of doing things.

"What they do, each of them, is shift the site of the decision elsewhere: to move it along. So, they displace the decisive moment to places where, seen from here, it seems no decision, but a fact."

(Mol, 1999, pp. 80)

Option and *reality*, as Mol wields it, share a space in which the dynamics of decision-making can be discussed and explored. The word *option* or *options* are used by Mol to exemplify why the notion of choice is certainly not a straightforward matter. It is complex and presents an enormous challenge (arguably many challenges) when realities meet and choices between them are made.

Mol also brings forth the concept of *interference*. Interference occurs when a seemingly unrelated reality becomes part of another. The example used by Mol, is how individual identity and biological difference of the sexes becomes part of detecting the disease anaemia. A particular way of detecting anaemia by statistical analysis suggests that there is a biological distinction between men and women (and pregnant women for that matter, whom somehow does not classify as women). The fear is, that this biological distinction of men and women could somehow be used as a tool in the gender debate. Therefore, evaluating the option of this particular method of anaemia detection requires an evaluation of the effect on the gender debate as well. The situation becomes so much more complex when a balancing of both realities is simultaneously required. But, as Mol suggests, since it's impossible to actually definitively fix the gender debate, perhaps it would be more fruitful to accept that the world is messy. And that the awareness of the interference is a good first step in

the right direction, and that the knowledge of the interference may be enough influence in which to weigh the options. (Mol, 1999, pp. 81-83)

Methodology

Now that we have established the basic epistemological foundations for this research, the question appears of how to capture these *webs of relations* that constitute the different solutions. And this can be a challenge - especially for our case, we would argue. Nuclear waste, power, weapons and history along with many other suffixes could be relevant topics to investigate for establishing on which relations our actors build their versions of the "best" solutions. Correspondingly, trust in systems, experts and politicians could be important for this establishment. And there are many more. The point here being that this is a very complex field, where our point of reference, education, access to the field and moral compass easily could be guiding for where, and on what premises, we choose to engage with our field. Thus, having impact on what the final report represents as a version of what is going on in Denmark.

This challenge of perspective and representation is often discussed in ANT literature, where Mol and Law states that "...a single text cannot be everywhere at once. It cannot do everything all at the same time nor tell all." (Law & Mol, 2002, pp. 5). Accepting this, they move on to the challenge of producing worthy representations of what is studied, where different examples are presented. Here we have taken inspiration from their notion of *walking*, which has emphasis on immersing the walker, i.e, the researcher, in a landscape or townscape where the goal is not to achieve an overview of anything - instead by walking, as one walks through the streets of a town or hidden paths in a jungle, then "As we walk, we may encounter a variety of comforting- or stunning- sights and situations, and then we can bring these together instead of leave them separate, as they would be on a map, removed from one another."(Law & Mol, 2002, pp. 16). And this is what we have done, we have walked through the field and let it unfold sights and situations that mattered at the sites we have visited. Walked through the field - it sounds like a pretty good metaphor to describe our approach, but what does it actually mean?

As mentioned earlier, we were invited to conduct this research by the chief consultant appointed to formulate recommendations for the policy makers. And in the ongoing process of stakeholder involvement they had established a contact forum consisting of representatives, that should include all stakeholder groups relevant to the decision at hand. This contact forum and the actors embedded became our starting point for this research, i.e. they became our definition of a field that we should be walking through.

Thus far, we have presented the notion of walking, and the field where the walking would take place. This could lead us to comforting and stunning sights that could be observed, interpreted and presented in the shape of a report about what we saw during our walks. But it is not that simple in

our case, and to show that, we have to further develop the notion of walking into something fitting for this kind of research being presented in this report. For we are not walking a city; we are walking in landscapes consisting of interpretations and opinions presented by *people*. And as the metaphor of walking in a city goes, one might be able to walk and quietly observe. We are more often than not positioned face to face in small physical spaces, co-constructing the landscapes through interviews and talks. In such scenery, we were bound to have impact on the topics of concern that the landscapes are being constructed upon.

Interviews

Acknowledging this challenge, we had to be careful in developing strategies that could strengthen our vision of *walking* the field and gathering intimate and, if possible, neutral depictions of our actors versions of the situation. Since the primary part of this study is based on interviews - eight to be exact, this method of inquiry had to be designed to enable the kind of empirical data we wanted to generate.

As an overall approach to all our interviews, we adopted the semi-structured interview as described by Kvale & Brinkmann(2008), who describes method of interviewing, as a facilitation of a conversation in which the researcher has the chance to get into close contact with the researched field and the people who inhabits it. The method is especially well suited as a way of achieving a better understanding for a single person or a smaller group of people's views and opinions on a topic chosen by the researcher. During the interview, the goal is to uncover what is often referred to as the interviewee's *life world* through the use of *qualitative conversation*. This is done by asking for the interviewees opinions and viewpoints, but also by allowing them to elaborate on and explain their concrete experiences and relation to those statements.

The reason for our adaptation of the semi-structured interview is in the prefix, since we, even though we initially had read vast amounts of material about the situation, still were able to keep finding more, which often only left us with the questions; Is this important for our research? - Should we invest *days, or even weeks*, in reading and learning about nuclear physics to in-depth, understand the composition of the Danish nuclear waste? Which would ensure that our forthcoming interviews with experts did not become a matter of them teaching us nuclear physics, but instead a matter of talking about the subject at a close to equal level. We decided not to. We put aside the book we had purchased that should introduce us to nuclear engineering, we stopped reading about foreign user involvement in nuclear waste programs. At this point we settled with what knowledge we had already acquired. Nowhere near close to in-depth in any regard, but yet enough to baffle colleagues

and friends when talking about the differences between alpha particles and gamma rays, and also enough to entice listeners when talking about the challenges of public involvement in nuclear waste programs. We had enough to begin generating our own empirical data through field interactions. And this is where the prefix, semi, would assist us in shaping the research and, if needed, direct us towards what more we needed to read about, but also, where our general direction for empirical generation should be focused.

The semi-structured interview can be said to change dynamically between two stages; the firm predetermined structure put forward by us, as researchers, and the potential unknown contributions of the informant. This is done in an effort to ensure that the interview touches upon all of the researcher's preliminary topics and questions, while still creating room for unforeseen elements of interest to spontaneously occur and be explored (Kvale et al, 2009). What this meant for us, was that our informants would become a guiding factor for narrowing down the focus of the research, and furthermore, be directing us towards which other actors that might be valuable to interview. So, while we would contact an informant and explain our agenda for the interview - the method of semi-structured interview, would leave room for the actual interview to focus on; both what we prepared, but also whatever our informants deemed vital to share with us regarding the issue at hand.

This way of approaching an interview, however, can be a challenging task. To predetermine when an unforeseen topic is still relevant or when it is somewhat derailed in not an easy evaluation to make. This especially becomes challenging during interview situations, because, you, the interviewer, also has to keep track of the the predetermined questions, whether they have been explored fully and consider what to ask next. This must all be done while still maintaining a meaningful conversation.

In our experience, we have learned that splitting those tasks between two interviewers gives more breathing room and allows for a better conversation. We do this by assigning each interviewer with certain tasks. One conducts the interview, while the other keeps track of the questions asked and adds additional questions if needed.

Returning to the metaphor of walking, the semi-structured method of interviewing was a method that ensured we were actually walking - not just mapping and filling in blanks in our predetermined version of what matters that was of concern regarding the issue. We were doing slow and care-full research as Law & Singleton would call it; *"Slow research is research that doesn't always take the lead. Instead it often follows. In woodwork, you sense the grain of the wood. Craft research is shaped by the patterns of interaction and practice that it's immersed in. You don't assume too much. You let the research unfold. You do care-full research."* (Law and Singleton, 2013 pp. 488) And this is what

ANT is about - being true to the field and giving the field the best possible circumstances to show us, as researchers, what really is at stake and of significance regarding the issue. Law & Singleton continues; *"Perhaps, then, ANT is best treated as sensibility; as a craft or a set of practices that works slowly both on and in the world; as uncertain; as empirically sensitive; as situated; and as passionate because it stays with the trouble."* (Law and Singleton, 2013 pp. 489).

And this "trouble" was exactly what we were after. From the beginning, we knew that deadlines had been passed and the process of solving Denmark's nuclear waste problem was in trouble because of various stakeholders acting as opposition to the established plans and ongoing process. But we did not know the underlying reasons for these stakeholders' opposition, and that, was what we set out to find. Why did certain stakeholders deviate from the ongoing translation of solving Denmark's nuclear waste problem? Where were the options, as presented by Mol, located in their presentations of the situation? We did not know in advance to our interviews.

In practical terms, we conducted eight interviews, and throughout these interviews the topics and focus areas evolved from each interview to the next. We have illustrated this in model X to exemplify how the first three interviews guided our research.

"The initial idea" refers to the beginning of our research, where what we knew was; a deadline regarding disposal of the waste had been passed due to implications involving civil resistance. There was an uncertainty regarding which solution that should be used. In other words, we knew that the translation towards disposing of the waste, had not been successful.

³Based on the initial idea, we constructed our first interview guide⁴ (annex 1⁵), that should serve the purpose of getting DD's version of why the deadline had been passed, and why a solution had not yet been determined.

What we gained from that interview, was an understanding that the difficulties were caused by misunderstanding towards risk and safety. Where they, DD, perceived the problem to be under control and without risk if handled in accordance to procedures. And the "others", i.e. those who did

³ Should be noted that this presentation of our interviews and our findings is a reduction that serves to illustrate our method, and not the entire content of our interviews.

⁴ Our interview with RISØ, was conducted partly during a tour at DD, where we got the opportunity to ask questions, and also through a small talk in the end, where different subjects could be expanded upon. For this reason, we do not classify our first interview, as semi-structured and such. Instead, the interview more had the character of an ethnographic interview as described by Kjeld Høgsbro (2008). In this kind of interview is characterized by dialogue, observations and clarification of the researchers understanding. Throughout this interview, we had the opportunity to see, touch and take pictures of the waste, while asking questions about it, and the whole situation in general.

⁵ Marked in blue represents our field notes written in short discussion after the visit. Notes that have been further elaborated through e-mail.

not share the same perception, had not been able to recognize that, roughly said, the experts and their procedures would ensure safe handling of the waste.

Based on this first interview we now had a sample of what was causing the difficulties:



1 INTERVIEW PROGRESS

Misunderstandings towards risk and safety.

Inspired by Adele Clarke's abductive approach to engaging the field, this sample now became incorporated into our further research, for what she calls theoretical sampling. The method is applied if the researcher has found something to be interesting, but still needs further confirmation to, whether or not, what has been identified is important for the research (Boolsen, 2010) (Clarke, 2003).

The next interview we conducted was with NOAH⁶, who we then questioned about risk perceptions. And what we received, was exemplifications of how different solutions each came with specific risks. And based on their perceptions on risk, they had decided on a specific solution that made sense to them as a "good" solution to the problem.

Furthermore, large parts of the interview revolved around their versions of why the handling the nuclear waste had been such a tedious process. To this, they talked about problems with classifications and unclear information flow from the government, but what we found most interesting, was how they defined the NIMBY syndrome as one of the main obstacles for further progress.

The last interview⁷ we here use to demonstrate our progress, was with Anne & Jens Albinus. In this interview, we still had the overall goal of getting their version of the situation, and have it explained through the topics they identified as important to explaining the challenge. But besides from this overall goal, we again confronted them with the theoretical samples we had already identified. We asked them about risk, and we learned that they also saw misconceptions about risk and safety as a large part of the problem. But they explained that many of the misconceptions were to be found within government and their related experts. Furthermore, it was added that, what had sparked their interest in the process, was a perception that the whole situation had been handled by untrustworthy experts, and that information was being withheld, thus depicting the whole situation as something secretive.

As for the next interview, we now had keywords such as: risk perception, NIMBY, trust and secrecy as theoretical samples that each had been semiotically constructed by our informants. These were, as described briefly above, moved on from interview to interview to narrow down and decide which parts of our field we should focus on in our hypothetical walk through it. This is how we wanted to make sure we stayed with the trouble.

Transcriptions

A few steps, that is what we are presenting as quotations have been through. And these *few steps*, are very important for a validity of our research. It begins with an interview, a social interaction composed of spoken words, gestures, body language, tone of voice, sarcasm and more. All able to define the semiotics of what is going on in the interview. These then become reduced to an audio

⁶ For Interview guide and transcription see annex 2.

⁷ For Interview guide and transcription see annex 3. For our remaining transcriptions, see annex 4.

recording, where we as researchers, are faced with the task of transforming the complexity of an interview into written words. These written words, now in Danish⁸ as it is the language spoken in the interviews, become subject to dissection through our analytical process. Pieces of text becomes removed from their context to serve as examples in our analysis, and when removed, the pieces once again have to go through another transformation from Danish to English to be applicable in our English written research. Hereon, the question surfaced of how to handle this challenge, and the answer is not granted in advance. As Kvale describes it "" Which kind of transcription is correct and valid?" (...) - there is no true, objective transformation from oral to written form. A more constructive question is: "Which transcription is useful for my[our] research goals?"" (Kvale & Brinkmann, 2008, pp 208-209). And what we wanted to extract from our interviews was simple: *meaning in context*. To do this, we fully transcribed all our interviews word for word in Danish and began analyzing based on these versions (elaborated on in the next section). When a cut-out of an interview had been determined to be included in the report, it was translated into English. To ensure that meaning was not lost in the translation, Danish counterparts was kept as attached comments in our draft documents for the purpose of revision by other group members. As to the aim of maintaining context in our presentations, we will present quotations in, sometimes, rather bulk pieces. Since, as we see it, if a piece of transcript (the words of an informant) can present the point we wish to established, then it should be allowed to. Better them, than us.

Actors (Informants)

The following is a short clarification of the actors included within the study, as well as a brief overview of their contributions.

NGOs

- <u>Sine Beuse Fauerby</u> Representative from *DN Danmarks Naturfredningsforening*, a Danish environmental organisation and member of the *contactforum*. (Contributions: Interview participant)
- <u>Tarjei Haaland</u> Representative from *Greenpeace Danmark*, an international environmental organisation and and member of the *contactforum*. (Contributions: Interview participant)
- <u>Niels Henrik Hooge</u> Representative from *NOAH Friends of the Earth*, a Danish environmental organisation and member of the *contactforum*. (Contributions: Interview participant)

⁸ Except for our interview with Johan Swahn, which was conducted in English.

Representatives of local citizen groups

- <u>Bent Dyrberg</u> Representative from *MORADS Foreningen mod radioaktivt affald i Skive, a* citizen group representing residents from the Danish town of Skive and member of the *contactforum*. (Contributions: Interview participant)
- <u>Bendy Poulsen</u> Representative from *Thyholmgruppen mod Atomaffald*, a citizen group representing residents in the general region of the Danish town of Thyholm and member of the *contactforum*. (Contributions: Interview participant)
- <u>Bodil Waagensen</u> Representative from *Lolland mod Atomaffald*, a citizen group representing the residents of the Danish Island of Lolland and member of the *contactforum*. (Contributions: Mail correspondence)

Others

- <u>Anne and Jens Albinus</u> Self engaged Danish citizens, active within the Danish debate of how to manage the country's nuclear waste. (Contributions: Interview participant and mail correspondence)
- <u>Kristoffer Brix Bertelsen</u> Representative from *Styrelsen for Videregående Uddannelser*, the Danish Ministry of Higher Education and Science ministry of education and science. Kristoffer functions as lead consultant on the case *"Preparation of the Decision by Danish Parliament on Management and Storage of Nuclear Waste in Denmark"*. He also sits in, and directs the *contactforum*. (Contributions: Interview participant and mail correspondence)
- Johan Swahn Swedish Expert within the field of radioactive waste management. Johan Swahn occupy the position as director of *MKG Miljöorganisationernas* kärnavfallsgranskning, the Swedish NGO Office for Nuclear Waste Review. Furthermore, he leads the radioactive waste management work of the European organisation *NTW Nuclear Transparency Watch* and sits as member of the *IPFM International Panel on Fissile Materials*". (Contributions: Interview participant)
- <u>Heidi Sjølin Thomsen</u> Representative from *DD Dansk Dekommissionering*, the governmentally established organization, tasked with decommissioning and disposing of the Danish nuclear waste and member of the *contactforum*. (Contributions: Guide and informant during field trip to Risø and mail correspondence)

Ethical considerations

During our empirical research, we made the purpose of our data collection clear to the participants. As informed consent (Kvale & Brinkmann, 2008, pp. 89) were given by every informant, we have (generally) chosen to not anonymize the statements and representations presented within this paper.

On rare occasions, informants have expressed a wish to not be quoted on certain matters, in which case, we have made sure to exclude these instances from the presented data.

Regarding our representation of the informants, we have attempted to present the data as truthfully as possible and to not distort the carried message. Evaluations of the content presented have been made to ensure that no one should feel misrepresented, uncomfortable or exposed. This have been done in regard to the consequences of our paper and to avoid potentially affecting preexisting, personal as well as collective, dynamics and relations negatively (Kvale & Brinkmann, 2008, pp. 92). Emphasis have been on inspiring constructivity rather than dispute.

Data analysis

Throughout our research, we accumulated a rather large amount of data consisting of; interviews, articles, reports, documents and radio and tv broadcasts. To help us organize and analyze this, we have used Nvivo - a computer assisted qualitative data analysis software.

Nodes	Cook for Search In • Nuclein • Nu	ar Waste Find Now Clear				
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	Fremtidsperspektiv	5	11	det Altså det vi kan forholde os til, det er, de der klassifikationssystemer som man ha		
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	- Hvad er en ekspert	3	-	med i atomenergiargentur regi nar jo undergaet ændringer nen over tid, på et tidspunk		
	Indfludelse og magt	2	0	bev aktiviteten joi naj grad delineret i fornoid til varmealgivelse fra analdet, samtidig r		
	Remerer intflutelre og magt	6	21	man også så på stralings intensitet, og der er man jo nok i dag gaet noget væk fra at li		
	Borgeres indrivaelse og magt	0	21	så meget vægt på varmeudviklingen, men mere at se på strålingsintensiteten. Og det		
	Informations dilemmaet	1	1	betyder jo også at hele den der kategorisering i hvorvidt noget er lav, mellem eller høja		
	Adgang til informationer	4	7	det bliver sådan lidt mindre interssant, fordi det man kan sige, det er, et anlæg skal jo		
	Bias Didit languaging india	1	6	beskytte mod den stråling der findes i affaldet. Så hvis der er en høj stråling, så skal a		
	Cad lammunikation	3	19	selvfølgeligt håndteres så man kan nå ned på de dosisbindinger som man kræver hos		
	God kommunikation	3	-	tilsynsmyndighederne. Så det er jo det danske synspunkt, det er jo sikkert også det DI		
	Involvering at borgere	5		GEUS har fortalt hvis i har snakket med dem, det er det synspunkt de fremfører, at		
	Aktivering	6	12	klassificeringen er sådan set underordnet, det der er det vigtige, det er, kan vi opbevar		
	Gennemsigtighed	2	2	sikkert? kan vi beskytte mod den stråling, uanset om den er høj eller den er lav, der ko		
	 Andre lande som det gode eksempel 	3	6	fra affaldet og det er in sådan set også lidt, så har der været en diskussion hvorvidt		
	Ingen gennemsigtighed	1	1	hvardan man ekulle karaktere, eller neten klassisiferer affaldet, leg ved at Anne Alhini		
	Mobilisering af borgere	2	2	hvordan man skulle karaktere, eller helop klassicilerer analder. Seg ved at Anne Albint		
Sources	 Organisering 	5	11	natt en dispute med vores uvildige ekspertpanel omkring om man nu skulle regne		
Nodes	Økonomi	3	4	emballagen med når man nu prøvede at beregne strålingsintensiteten eller		
Classifications	Repræsentation	3 3 strålingsaktiviteten i affaldet. Og altså, der er jo ikke andet at sige til det, er	strälingsaktiviteten i affaldet. Og altså, der er jo ikke andet at sige til det, end det er jo			
Collections	 Kategoriseringen af de 233 kg Historisk 	5	13	hvis man, man kan jo regne det her ud på lige så mange måder som man har lyst til. E		
Conections	- Kontaktforum	4	4	klart, hvis man som Anne Albinus ønsker at kunne demonstrerer et vanvittigt højt		
Quenes	Mellemlageret	2	2 -			

In our analytical process, we have walked through our collected data, cut out parts, and assigned these specific codes. In doing so, we have created 60 different categories, or *nodes*, in Nvivo vocabulary. Each of these categories had been solely created by processing our data, locating interesting pieces, and reducing them to a single word or a sentence, that we deemed would capture the essence of the pieces.

After going through all our data, we could now identify which categories that had attained the most attention from data - and thereby us. Not surprisingly, the largest categories were those we had already foreshadowed. Which also may be an indication of our influence on process.

The above screenshot is of the Nvivo user interface. On the right, we have the transcript of one of our interviews and on the left, a list of the categories we have created through our coding process.

Analysis

The problematization of the Danish nuclear waste problem

In 2003, Parliament passed a motion that would allow the government to prepare a basis for decision on how to dispose of the Danish nuclear waste. The motion description B48, describes some potential solutions to the problem as well as some of the challenges that might occur during the process. The motion was unanimously passed in Parliament as the strategic foundation for establishing a waste solution.

"The parliament gives its consent to, that the government, at the same time as the decommissioning, commences the preparations for a basis for decision regarding a Danish final repository for low and intermediate active waste." (B48, 2003)

B48 is based on Dansk Dekommissionering's (DD) report "*Theoretical elucidation of the technical demands for a Danish final repository for nuclear waste*" (DD, 2002). COWI and associates⁹ were hired by the government to evaluate the report and to propose a strategy for establishing a final repository to dispose of the Danish nuclear waste (COWI et al, 2002).

Based on this motion, we present, inspired by Callon's concept of translation, an illustration of the problematization in 2003.

In the center of the translation we place the government and the connected experts who supplied the fundamental material, i.e. DD and COWI. We will present what we identify as their main objective in the motion, and we will present all entities they identify as important in relation to achieving their objective, and we will present how each entity is identified as possessing embedded obstacle problems that challenges achieving the main objective.

Translating nuclear waste

To begin with, the challenge was not how to dispose of the waste. It was rather a more general question of how to decommission the nuclear facilities at Risø. The challenge of how to dispose of the waste existed as a secondary, but necessary part of the decommissioning project. As such, the focus has been divided between the many challenges this larger project presents. A broader assembly of issues from which the question of a waste disposal method is a part.

⁹ Consortium consisting of COWI with participation of several other engineering consultancy companies.

The translations towards disposal of the nuclear waste began in 2001, but there is an important story to tell about the history leading up to the actual process of disposal.

In 1958 Risø Research Center was inaugurated on the peninsula Risø, near Roskilde. It opened with operations of the DR1 reactor, which was shortly followed by the DR2 reactor and finally the DR3 reactor in 1960. The capacity of these reactors were respectively 2 kW, 5 mW and 10 mW (Knudsen, 2006). For comparison of power output scale, Barsebäck, a nuclear power plant in the neighboring country of Sweden had a total output of 1140 mW from two reactors (bbk, 2016).

In 1985, a bill regarding an abandonment of nuclear technologies in all future energy planning in Denmark was approved by parliament, and an already decreasing interest in nuclear power was ratified by law. The DR2 reactor had ceased operations in 1975, and the two other reactors were ageing, thus requiring increased maintenance to stay operational. Eventually, in 2000 the largest of the three nuclear reactors within Risøs facilities, DR3, was taken out of service due to suspicions of leakage. It was reported that significant corrosion had been detected and assessments abouts its continued operations had to be made. It was decided by the board, that, because of its age, which was already approaching the end of its estimated lifespan, and combined with the cost it would take to make the necessary repairs, not to restart DR3. In addition to this, it was also decided that all other nuclear facilities within the research center were to be shut down, since DR3, due to its larger size, accounted for the majority of the research potential, and continued operation without it, would not be meaningful. DR1 was taken out of service one year later in 2001.

At this point in time, Risø Research Facility was already storing nuclear waste from over 40 years of operations and was now facing the challenge of decommissioning the nuclear facilities, which would produce even more waste since large parts of the facilities had become radioactive throughout their years of operations.

The decommissioning of Risø and the disposal of the nuclear waste is seen as a final act to end all nuclear activities in Denmark. Denmark would finally become a nuclear free country.

The problematization of B48

In Callon's presentation of the translation, a central is an actor who attempts to solve an issue by domesticating both natural and social actors. The central actors, the actors who try to fit all the other relevant actors under the obligatory passage point, are the researchers. This represents a rather linear storyline, with a static, central actor. Our situation is different. The domesticating, central actor in this case has a more dynamic nature. Instead of three researchers, we consider the government (or more precisely the ministry whose task it is to supervise and steer the process, who

is then acting in the interests of the current government) and the experts they have allied themselves with as the central actor to perform this translation. The experts consist of several groups; Risø & DD (which in the beginning of the decommissioning project may be seen as the same actor until the Risø staff dwindles away and only DD remains), COWI and associates (which is a consortium of a large number of international experts in the field of both decommissioning and nuclear waste management), and finally GEUS¹⁰. Each of these actors collaborate to create the translation of how to handle the nuclear waste. The basis of decision which they have been tasked with creating, is then both the sum of their problematization and the interessement device that is supposed to enrol Parliament. If they are not successful in enrolling Parliament, then the waste will not be disposed of.

The element of interest for this part of the analysis is the problematization of the Danish nuclear waste problem and the identification of the supplementary actors, the interactions with these actors and their interdependent relationships. Of these supplementary actors, several have been identified by the central actors, to have a role in the coming nuclear waste handling. These include: The public, legislations and obligations, the waste, the geology of Denmark and repository concepts. To dispose of the waste, these actors have to be fully identified and enrolled.

Legislations and regulations

In DD's report, attention was directed towards the legislative and regulative factors that would become determining for the establishment of a final repository in Denmark. To elucidate the importance, DD lists 12 relevant provisions and obligations and notes, that they do not represent the entirety, but merely a sample of the legal implications such a project might include. The extent to which such legal and regulatory implications may affect the construction of a final repository may be even more comprehensive. Furthermore, as members of the European Union and the United Nations, Denmark is enrolled in international law. This means that the Danish obligations towards the handling of radioactive waste falls under these institutions' regulations and legislations. As a result thereof, the Danish law within the field cannot be decided purely nationally, but must be in accordance with the framework of these institutions. This, however, does not mean that member states have to adopt the exact guidelines provided. Deviation is allowed (and commonly practiced) as long as national adaptations improves upon or, at least still are in compliance with international law.

¹⁰ The national geological investigations for Denmark and Greenland

To better illustrate the legal and regulative framework that applies, we want to highlight a few of the regulations mentioned by DD, that we have observed to be especially relevant to the early problematization of the waste problem.

When constructing facilities that potentially affect the environment, and especially when dealing with radioactive matter, the planning and execution of such projects becomes heavily regulated. One such regulation is the Danish "Planloven", which dictates that assessments of project location, design and environmental effects must be made before any construction begins. Similar obligations also exist within international law, namely the EURATOM directives, which dictates that information concerning any plans for disposing of nuclear waste must be provided to the EU commission to be assessed for potential risk of contaminating other member states' waters, lands or airspace.

The Basel Convention states that radioactive waste should, as far as it is possible, be disposed of in the country it was generated. This causes export of the Danish waste to be problematic if Denmark is not first determined to be unsuitable for a nuclear waste repository in one way or another.

The Aarhus Convention is intended to ensure citizens' rights within the environmental field. It requires public participation in the decision-making process, access to information as well as complaints and court decisions concerning the environment. Public participation has previously proven to be important to the socio-political success of radioactive waste disposal programs as well as nuclear science initiatives in general.

These rules and regulations have implications in relation to the planning process, since the framework the project will operate within must be thoroughly researched before any construction commences. Additionally, these rules and legislations represent a rather rigid actor, one that cannot easily be negotiated with. Rather, the central actors must fully identify the legislations and obligations relevant to the problematization and shape their plans accordingly.

The public

In COWI's evaluation of DD's report on how to handle the nuclear waste, they identify the public as an actor who might be resistant to the solutions proposed by the central actor.

They recommend that the entire process should be strategized with stakeholder involvement in mind. In relation to this, stakeholder involvement is considered a crucial factor in regard to both evaluating proposed solutions and the siting process for final repositories.

The proposed causes for resistance by the public are as following:

- Fear that if an effective solution to the waste problem is decided, this will give green light for further exploration of nuclear technologies that they oppose for other reasons.
- Distrust in experts in general, and especially in the nuclear experts, who back in the day, presented nuclear as clean, cheap and safer.
- A conviction that the effects of small doses of nuclear radiation are far more dangerous than proposed by international experts.
- The belief that better waste management technologies will be developed in the future. (COWI, 2002)

Seeing as this actor historically has been one of the largest obstacles (and the most difficult to handle) in final repository implementation, COWI emphasizes that all stakeholders who could be interested in the decision, should be an integral part of the decision-making process.

Based on international experience, the process of implementing means of disposing the radioactive waste is a long one. But if the process meets resistance from the public - all bets are off:

"International experience show, that it must be expected to take a considerable amount of time from planning of a final repository to the actual construction and implementation. Even if the entire process runs seamlessly, and no delaying factors occur, the timeframe is still 7-11 years from start to beginning (Finland and Norway). If one experiences siting issues, both the timeframe and expenditures become unpredictable (Germany and Belgium)." (B48, 2003)

In other words, the government identifies the public, in relation to the siting process, as a potential obstacle if not handled correctly. Part of their strategy, then, is to incorporate the public and other interested parties in hearings.

"The government will hereafter, as part of their desire of openness and incorporation of the public, municipalities and other authorities, present this proposal in an open hearing process. Parliament could hereafter be presented basis for decision as robust as possible." (B48, 2003)

As part of the central actor's problematization, they plan to shape the process in a way that emphasizes inclusion and transparency, to avoid creating *a public* who could complicate the process. The hearings in this scenario, will then be the interessement devices meant to enrol the public. But who exactly is the public in this situation? In COWI's evaluation, they describe the public as either local communities, or NGO's. This is interesting, because *local* communities only exist, if they have something to be local to. Which means that the part of the public known as local communities does
not exist before potential locations for a nuclear waste facility has been proposed. Hosting a hearing before the siting process can then only really incorporate the part of the public identified as NGOs.

The nuclear waste

About half of the nuclear waste to be handled was accumulated over almost half a century of the nuclear endeavors at Risø. The other half will be produced by the decommissioning of the Risø facilities. Only a small portion of radioactive waste is produced outside of Risø, at about eight cubic meters per year, or just under two tonnes (including packaging material, which is quite substantial).

Based on DD's report from 2002, most of the waste falls under the category LILW-SL (Low and intermediate level waste - short lived), which is fairly straight forward to dispose of. A small amount of the waste is categorised as LILW-LL (long lived). Long lived waste requires a different disposal method, since it must be kept separate from the environment for that much longer. An even smaller amount of the waste, referred to as the *special waste*¹¹, is 233 kg spent fuel, which DD at this point describes as high level waste, in principal. There is some confusion on the matter, however. High level waste is usually associated with a substantial heat generation, which the special waste is said *not* to have. The categorization of the special waste is therefore a delicate matter. DD recommends, that the special waste is considered dealt with separately from the rest of the waste, since the recommended method of disposal for spent fuel is in a deep geological repository - A very expensive solution for such a small amount of the nation (DD, 2002).

Another challenge with the waste is large amounts of uranium ore (3.670t) and uranium extractions called *tailings* (1.130t), which is currently stored in two large basins at Risø. It is stored that way to avoid radon leakage. DD notes, that the tailings and the ore should also be considered dealt with separately from the rest of the waste.

COWI noted that there were seemingly no classification system in place for the Danish nuclear waste, and that it would be beneficial to define classifications, which for example, could be established based on IAEA principles. A classification would enable a determination of what parts of the waste that should be considered radioactive and what parts that could be exempt from the inventory of nuclear waste. It was added that an exact estimate of mass, volume and categories needed to be created and a national registry established.

¹¹ Actually, the special waste as of the 2002 description by DD covers a lot of other radioactive sources such as heavy water, and not just the 233 kg spent test fuel. But, to avoid confusion, we decide to just refer to the special waste as the spent fuel, since that reflects how it is used and discussed as of 2017.

The need for a classification of the waste tell us that the waste is not fully identified. What it is and how to handle it therefore obviously requires further investigation into its identity. The act of classifying the waste is the interessement device meant to assist in enrolling the waste.

Physiographic siting

The procedure of determining a location for the final repository is described as no simple matter. In their report, DD points to a list produced by IAEA, of elements that should be included into the process of choosing a suitable location for a final repository. This list is extensive, and even though it can be argued that it is rather loose and imprecise, it depicts the task of examining and determining a location as a comprehensive project. In the following, we will put forth some of the factors mentioned in terms of locating a suitable site.

The geology is often mentioned as an important factor in determining a suitable location, however, the relevant factors when searching for a safe environment for a final repository is not purely geological. Other related factors, such as *hydrology*, *geochemistry* and *tectonics* are also emphasised as important. These factors, even though they are related, addresses different versions of what some may broadly described as *geology*, or as we will argue later may be described with a more befitting word, *physiography*.

In relation to the *geology*, DD's report states that predictable and uniform geological formations is preferable. Furthermore, it is noted that *"the geological conditions should contribute to the encapsulation of the waste, in limiting the emission of radionuclides as well as support the physical stability of the structure (DD, 2002, pp.38)."*

As such, what good "geology" is, in this instance refers to a certain set of properties, whereas hydrological conditions refers to the presence of groundwater and the potential effects and relations between that environment and a nuclear waste repository. Knowledge about the flow rate and direction of the groundwater as well as regional or seasonal fluctuation of the groundwater level is mentioned as important when evaluating the suitability of a location. It is stated that low groundwater flow and long flow patterns as well as simple hydrological systems are preferable.

Geochemistry also partly refers to the groundwater, however, it is mainly concerned with the the geochemical conditions such as Ph value of the water as well as the retention properties of the geological materials. These factors are especially important to ensure that the geological materials, due to their geochemical properties, are not corrosive to concrete thereby causing degradation of the man-made barriers. Furthermore, it is stated that *"the geochemical properties of the groundwater and geology must contribute in slowing down the spill of radionuclides (DD, 2002, Content and Content and Section 2002)*.

pp.38)", suggesting that geochemical compositions of the ground might not be of a problematic nature but actually cooperate with the purpose encapsulation.

Tectonics are directly related to the risk of earthquakes and the potential harm to a repository such as seismic activity could cause. It is stated that the repository should be placed in an area of low tectonic and seismic activity and that old *subductions zones*¹² should be taken into consideration.

Lastly, in DD's report, *meteorology* and *surface processes* is also mentioned. These two categories have largely moved away from what may be described as geologic factors. However, they still represent "naturally" occurring elements that influence conditions relevant to potential suitable locations (ibid. pp. 39).

In relation to the *meteorology*, it is stated that the occurrence of rough weather, and changes in climate, precipitation and groundwater levels must be accounted for. Largely, this could be said to be the weather's effects whereas "surface processes" on the other hand refers to the landscapes effects and its continuous change due to surface processes. This is important in terms of avoiding potential floods and landslides and includes considerations about topography like a locations height in relation to the sea level or drainage possibilities in case of the previously mentioned floods.

The siting procedure of a final repository, as we have explored in the above presented points, is not perceived as merely a geological matter, but include a multitude of different elements that must be considered.

A large emphasis is definitely put on geological conditions, however, we have found it more suitable to use the word *physiographic* location or factors to better frame the entirety of the relevant elements. All complex factors that must be thoroughly and scientifically researched and determined before a potential location can be pointed out.

Sociographic location (Finding a suitable location)

Additionally, to the aforementioned physiographic conditions, DD adds additional requirements, which may be referred to as social elements. These cover factors like population density, current land use and ownership, infrastructure, future constructions plans and activities, and finally, attention towards aesthetically and socially valued areas.

¹² Breaking zones in the earth's crust that are subject to earthquakes due to friction between tectonic plates.

In the following, we will present the relevant points within three main fields of attention, which are based on our condensation of DD's recommendations. Like *physiographic* considerations, we have chosen to refer broadly to these as *sociographic* considerations.

It is stated that areas with high population density should, if possible, be avoided. Furthermore, a possible site should be chosen based on availability of infrastructure for transportation of nuclear waste, and especially important for the Danish case; the proximity and availability of the Danish emergency management agency¹³.

Whereas these elements mainly addresses the logistical and structural composition of Denmark, the next field of attention was concerned with alternate use and value of land. It is suggested that previously established ownership of land may be a step towards gaining the public's acceptance of the construction of a final repository. It should minimize potential conflict with any current use or future use or development of land. Because of this, use of an area for nuclear waste disposal must be viewed in relation to the potential value and other potential uses of the land.

Finally, we see a special attention towards what they refer to as the surrounding environment, meaning areas with certain public, natural, historic or archaeological value.

Where to it is mentioned that a facility should be introduced to the landscape in a reasonable and aesthetic manner and that these environmental regards should be considered throughout all phases of the repository's construction and operation, as well as after the sealing of the repository.

In the end, these conditions, both *sociographic* and *physiographic*, are to be the fundamental factors that will enable siting of a final repository in Denmark.

And this is the problematization of location; a list of conditions that will be applied to transform and mobilize a physical version of Denmark, into a version where it would make sense to place a final repository.

Repositories

In the preliminary report by DD, three different repository concepts are presented as possible solutions (DD, 2002. pp. 41-45). These solutions are all heavily connected to the identification of the waste and the physiographic and sociographic criteria.

¹³ "Beredskabsstyrelsen" in Danish

Bunker

The first repository design is a concrete bunker placed on the surface - a solution with little requirements towards geographical siting. The only geographical siting requirements for this solution are, that there is no risk of flooding and a stable geology, as in little to no tectonic or seismic activity, which makes the solution available in almost all of Denmark.

Surface-near Silo

The second solution is a concrete silo placed 20-50 meters below the surface. This solution has a few requirements towards geographical placement. It is important that hydrological and geological conditions are well-understood before moving forward with such a solution. Where to it is added that compact clay would be preferable, but even water-bearing clay, could also be a possibility.

Deep geological

The third solution, deep geological disposal at 200-2000 meters below the surface, also had high geological requirements. A possible site should consist of a thick layer of homogenous clay, which could act as thick barriers any leak would have to pass through. Deep geological disposal would be suitable for all types of radioactive waste, since the thick layers of clay would encapsulate the waste for such a long time, that even long-lived isotopes would disappear due to decay. (ibid)

The interdependent relationship between physiography, sociography, the nuclear waste and repository concepts.

In the COWI report, it is proposed that large emphasis should be placed on the establishment of a strategy regarding the implementation of a final repository as a solution.

The most pressing issue regarding the strategy would be in defining whether it's objective of disposal was to concern handling of the entire inventory of nuclear waste, or if only parts was to be included in the strategy. To exemplify the importance of clarity regarding this issue, they explain that a strategy including all waste, would possibly amount in further development of a strategy that was centered around a solution that would be suitable for the entire inventory, where to deep geological disposal is presented as an example. If, on the other hand, only the short-lived and low-level waste was the objective of the strategy, then focus should be directed towards surface near concepts or other alternatives (COWI et al, 2002 pp.4-5). However, to decide on any of these strategies, further identification of the waste and the geology was needed.

In motion B48, the option of exporting low and medium level waste was evaluated, and even though the option existed as a legal possibility, it is shelved due to the fact that it was regarded as an expensive solution, and also to a compliance attitude towards an international nuclear waste

convention which stated; "Convinced that radioactive waste should, as far as is compatible with the safety of the management of such material, be disposed of in the State in which it was generated, whilst recognizing that, in certain circumstances, safe and efficient management of spent fuel and radioactive waste might be fostered through agreements among Contracting Parties to use facilities in one of them for the benefit of the other Parties, particularly where waste originates from joint projects" (IAEA, 1997). In conjunction with the overall standpoint of Parliament that Denmark should dispose of waste produced in Denmark, it was added that, regarding the 233 kilos special waste, which due to containing a relatively large amount of long lived isotopes, would require special attention when a final repository solution would have to be decided upon. Identifying other means of dealing with the special waste is a large part of identifying the nuclear waste of Denmark, and therefore has a great impact on the possible future strategies.

When all criteria for evaluation have been established, a selection of possible solutions should be identified and evaluated in a structured and transparent manner, where all stakeholders that could hold an opinion, are involved in the evaluation process. The evaluation should thoroughly describe which criteria that had been used in the evaluation and should consider how the results of all evaluations would differentiate if larger emphasis had been placed on other criteria than the ones used.

An example of this is shown by an excerpt from the B48 description:

"Additionally, a choice must be made of the preferred type of repository: Should it be a closed or an open (reversible) repository. A closed repository means that the construction would be inaccessible (for example sealed with concrete). Thus, security is increased. An open repository entails, that after a closure and securing of the repository, it would still be relatively easy to acquire access. It would then be possible to continue adding radioactive material and remove it again. Furthermore, considerations must also be given to whether the repository should be saturated or not." (B48, 2003)

Retrievability and easy access to the facility is mutually exclusive to security. Even though a reversible repository solves several issues, it also increases the risk of unauthorized access and sabotage. A weighing of options is required. This is just one of the evaluations, that they recommend involving all interested stakeholders in.

The design of the repository thus involves all other actors relevant to the problematization. The physiographic and sociographic parameters dictate the physical location *and* the available repository concepts, much like the waste does. The legal obligations limit the options available for otherwise

dealing with waste. Meanwhile the public must have trust in the competence and the abilities of the central actors to the extent in which they do not object to their strategy. In other words, the repository can only be realized, if all the other actors have been successfully enrolled.

At this point in the translation, they have only identified the relevant actors that need further investigation, before a specific obligatory passage point can be established. With the blessing of Parliament, their task at hand is to enrol these actors.

The attempted interessement of the supplementary actors

In this next chapter, we will consider the different interessement devices orchestrated by the government in an effort to enrol the necessary actors in the period 2003 until 2011.

The mini-hearing (2005)

The event of 2005 is based on a brochure published by the Ministry of health titled *slutdepot for radioaktivt affald i Danmark, Juni 2005 (SUM, 2005)* The brochure was meant as literature describing the preliminary progress of the authorities' plans to dispose of Denmark's radioactive waste and to create the framework for a discussion to be had during a mini hearing arranged shortly after. To present the discussions that transpired during the mini hearing, the government released a summary, which unfortunately does not specify who made each statement. It only serves to describe the topics that were discussed and what conclusions were made. The following excerpts from the summary explain the purpose of the hearing: *"It was clarified, that the meeting first and foremost regards the technical and the administrative processes, since the political aspects in regard to the repository is not definitively specified yet."* and: *"This hearing has been convened partly to explain the work of the task force up until now and partly to receive input from NGOs and other organizations."*

Worth mentioning is the fact that many NGOs were invited to participate in the hearing, but only one, Greenpeace, attended. Since the central actors identified the public as a potential obstacle in regard to the siting process, and that the idea of hearings was supposed to be a solution to this obstacle (at least partially), we find it obvious to scrutinize how they presented their plans for finding a location.

"It is complicated to find a suitable location to place a final repository for radioactive waste. IAEA recommends that one begins with selecting potential areas for the placement of the repository based on already available data on geological, hydrological and topographical conditions. This will work as a framework for which areas, that generally meets the requirements for a final repository for radioactive waste.

One possible procedure could be pointing out about 20 areas with suitable conditions. Afterwards one would describe and assess the location-specific conditions such as; land use, environment, nature and transport, as well as social and cultural aspects. Based on this, a smaller number of areas should be selected for more detailed investigations.

The detailed studies will mainly consist of actual technical field studies in the form of drillings, measurements and monitoring programs. Alongside these studies, safety assessments and environmental assessments will be performed. Decisions on technical issues, such as repository concepts that may affect the possible geographical locations of a Danish final repository will be in line with other significant decisions.

The entire selection process must be in close contact with local authorities and the interested public." (SUM, 2005)

The proposed procedure is not much different, than what was recommended by COWI and described in B48. With the promise of substantial involvement of both the public and other relevant local authorities, the process seems to be going according to plan. During the hearing, this procedure was not particularly discussed. Except for discussions on the necessity of the iterative and comprehensive nature of the process, for which it was informed that it was almost impossible not to take a few steps back once in a while, in a project like this.

Mobilization issues of 2005

In both the brochure and in B48, the public is described as either NGOs, local communities or interested public. The only one in attendance who resemble either of these descriptions, is Greenpeace. Any feedback or criticism from the public is then reduced to the contributions made by Greenpeace. As mentioned above, the summary of the hearing does not specify who gave each statement. Measuring or analyzing Greenpeace's contribution is therefore not possible based on the summary. Nevertheless, to accept Greenpeace as the negotiator and the representative of the public as the central actor themselves have identified the public seems... Wrong? Hopefully they will not claim to have given the local communities plenty of opportunities to get involved based on this mini hearing.¹⁴ (They will)

We can also claim with some degree of certainty, that this mini-hearing is the only interessement device aimed at involving or enrolling the public in either of its shapes, pre-2011. Whether or not Greenpeace were *successfully* enrolled at this point is also hard to assess, based on the summary of the hearing. But since no definitive plans or sites were proposed, enrolling an actor to the cause is obviously more difficult (or perhaps just less meaningful), since the obligatory passage point at this point is still relatively unspecified (since they are yet to propose both site and repository concept).

¹⁴ Except for a written hearing following the basis for decision published in 2008. All responses to this hearing were received past the due date and have, for a reason unknown to us, not been published on any government websites. We were able to dig up one of the responses with a little help from our connections to the field, but we were unable to dig up the remaining 7. We have therefore chosen not to include them, especially since the government did not respond to them.

Objecting to them trying to find the safest and smartest solution to dispose of the waste does not really make sense, does it?

Alternative disposal methods

The brochure also proposes new disposal methods, which were not described in any previous documents. To better deal with the Danish nuclear waste, a deep borehole was suggested. A deep borehole is a variation of a deep geological repository, and is performed in the same way as groundwater or mineral drilling. It is financially a better solution for highly radioactive waste (such as the special waste) in smaller quantities. Dealing with the special waste separately from the rest opens the possibilities of storing the bulk of the waste differently. However, during the hearing, they discuss this issue and it was explained that there were other long lived sources of radiation, that needed to be dealt with also. Which means that exporting or otherwise dealing with the special waste is not enough for the rest of the waste to be stored in a surface-near repository. One of these problems is the sorting of the waste, since some of the other long-lived sources are packaged with other short-lived waste, meaning a sorting and subsequent repackaging is required. Nevertheless, during the hearing they conclude that a near-surface repository combined with a deep borehole *might* be sufficient in safely disposing of the Danish radioactive waste.

Basis for decision (2008-09)

As it was stated in B48, the government would begin work on a basis for decision on how to deal with the Danish nuclear waste. However, in 2008, there were still many elements of the issue that needed attention, and a clear basis for decision for political deliberations was not yet possible. Instead, they presented parliament with a statement (to attain preliminary confirmation that the procedural efforts of the government, DD and GEUS were in accordance with the wishes of parliament). This chapter is based on the basis for decision (which it was titled, even though it was not a basis for decision. It is confusing, we apologize) and the summary of the political deliberations in Parliament.

The statement was deliberated in parliament for about 30 minutes. Most of which was regarding the coming siting process, and how it would impact the process: *"I believe that we might as well admit that the discussion does not begin here. The discussion begins when we have to find the concrete places to put the waste, and it has no public interest until that time. It is obviously good, that we have prepared the process, but one can easily say, that the actual discussion comes later, and good luck with that; it is going to be quite difficult. Thank you."*

(FT, 2009 - Lone Dybkjær (RV))

Reversibility

The need for reversibility in a final repository is described in two different scenarios in the basis for decision description; one, in case of acquiring new knowledge, resulting in a safer method or place for disposal. Two, in case of technological advancement, which turns the waste into a resource rather than waste.

These examples are explained as the only scenarios in which the waste would be later removed from the repository. The first scenario is rather superficially dismissed, with a recommendation to adequately dispose of the waste, so a future relocating of the waste is not necessary. The second scenario is dismissed with a description of the bulk of the waste actually being waste, rather than spent fuel, and concluding that the amount of spent fuel among the Danish nuclear waste is so insignificantly small, that it would not be worth the hassle of extracting it from the repository. Unless the facility is designed in a way, that only the cell within the facility that contains the small amount of spent fuel, is made reversible.

During the deliberations, reversibility is mentioned by many members of parliament as a sensible quality of whichever solution is chosen. The two most mentioned reasons why the repository should

be reversible is; one, that the experts may not have thought of everything, and two, since the construction is meant to safeguard the waste for up to 300 years, unexpected events may occur. These two elements combined with the dangerous and "mystical" nature of radioactive material creates unease and a general distrust in the experts. Not necessarily distrusting their competence or ability, but distrust in science in general, since, as the members of parliament puts it, science is always pushing forward, learning new things. Perhaps a better solution is thought of in 50 years, or perhaps scientists learn that the chosen concept is flawed. In either case, preparing for the worst is making sure the repository is reversible. (FT, 2009)

This negotiation between the central actors and Parliament is a good example of how their problematizations of the Danish nuclear waste problem are different. The premises of which the DD have based their problematization is not recognized by the members of Parliament.

International expertise

It is also worth briefly noting, that weight is also put on the use of international expertise, as suggested by basis for decision. The parliament agrees that confirming strategies with international experts is a good idea, and that money should not be hindrance for thorough research of the subject (FT, 2009 - Søren Gade (SF))

The waste and new repository concepts

The basis for decision acts as a delineation of the possible repository concepts, partly based on the attempts of domesticating the waste. Changes are made in the identification of the waste, which ultimately dictates the shape of the available repository concepts. However, it should be mentioned that the description of the waste in the first reports from 2003 and again in 2005, are relatively less detailed than they are in 2008 (as were their intention). Notable changes in the identification of the waste are:

 The uranium ore, which was previously considered part of the waste inventory, may be categorized as NORM¹⁵ waste or a raw material. It may therefore not necessarily have to be disposed of with the rest of the waste. It is not yet decided how to handle it

¹⁵ Naturally-Occurring-Radioactive-Materials

- The continued source of waste from hospitals, industry and research in the amount of 2 tonnes annually, should be included in the planning of the repository concept
- A large amount of the waste contains dangerous materials that are not radioactive. Which means, that even after the radioactivity has dissipated, the waste will still have to be classified as dangerous waste, since it is not possible to separate the dangerous waste from the radioactive waste.
- The tailings, which should be covered with water to avoid radon gas leaks, may not be suitable for disposal above groundwater deposits, as the storage method has an increased chance of leakage into the surrounding area, thereby contaminating the water, effectively spoiling drinking water interests.
- It is defined that Denmark is not in possession of high level radioactive waste (HLW), which in other words mean, that the special waste is definitively not considered HLW at this point.

What we can deduct from the report is that changes are made in the identification of the different actors involved. What we are missing, however, are the calculations of how they got there. For example, how they decided that the special waste is not HLW. The interessement devices they used to negotiate with the waste are missing from the reports. They do not explain which methods of waste classifications they used to determine activity levels in waste.

Feasibility studies (2011)

In 2011, three separate studies and a summary of these were published. This chapter is based on these publications, most important of which was the report by GEUS, which was based on preexisting data, to determine which areas to study further. (GEUS, et al., 2011)

Criteria for geological siting

GEUS had created a list of criteria relevant to finding a suitable location for a final repository. These include:

- Large areas of horizontal homogeneous geology
- Low permeability
- Areas with special drinking water interests are excluded
- Drinking water interests are hard to avoid altogether, but is still a factor to be avoided if possible
- Conservation areas and densely populated areas are excluded
- Areas that are threatened by climate change are excluded (GEUS, et al., 2011, p. 29)

To find a suitable site, the first thing GEUS did was to exclude all the areas with high permeability, special drinking water interest, densely populated areas and inconsistent geology. The number of areas of interest was then reduced to 22. Thorough analysis of these areas, mostly based on their geological composition and tectonic activity, resulted in six areas chosen for further studying. All areas are shown in figure X

Hvidbjerg, Thyholm, western Jutland

This area is of interest due to its thick layers of clay, limited drinking water interests and no future climate change threats. It is mentioned that the area may be affected by tectonic activity, but only to a limited extent.

Thise, Salling, Skive municipality, Jutland

The composition of clay, in combination with limited drinking water interests, is what makes this area interesting to GEUS.

Skive West, Jutland

The composition of clay may host a final repository, and there are limited to no drinking water interests in the area. Some parts of the area may be affected by climate change in the future, which will have to be taken into account.



Bornholm

2 MAP OF THE PROPOSED LOCATIONS

We have chosen to highlight these areas mainly because we will return to them later in this report. The rest of the six areas are chosen for similar reasons. The common denominator is that all of these areas supposedly have horizontal layers of homogenous geology with low to no drinking water interests. This activity as performed by GEUS, is the interessement device used to domesticate the geology. The geology in this scenario is mobilized into pre-existing data, which they recognize may not fully account for the actual geology in these locations. Well aware of the issues of this mobilization, the next step is to do a field study of the six chosen locations to confirm whether or not they are suitable for a final repository.

Repository concepts

Since the basis for decision in 2008, not much have changed regarding the recommended repository concepts. Most of all, the feasibility studies of 2011 describe the interdependent relationship between repository concepts, the waste and the geology. That to narrow the choices of repository concepts, further knowledge about the waste and the geology is needed, and as of 2011, the preliminary repository concepts are:

- Surface near repository (if they special waste can be otherwise dealt with, by exporting it, for example)
- Surface near repository in combination with a deep borehole for the special waste
- Medium deep repository for all the waste, just below the groundwater. (GEUS, et al., 2011)

It is then mentioned, that surface near repositories are most vulnerable to accidents. To avoid accidents such as a crashing plane or a drilling, they suggest a strong visual presence on the site. The effects of reversibility are also discussed in concrete situations based on the three repository concepts suggested. First of all, a deep borehole cannot be made reversible. And, as mentioned before, reversibility decreases the security of the facility. In other words, they have incorporated substantial plans for how the different repository concepts can be made reversible as well as how much extra it would cost. We interpret this as the central actor accepting Parliament's wishes for the option of reversibility concept to remain open. Interestingly, the report makes no recommendations as to whether it *should* be reversible. It only describes the practical aspects of how it could be done, and what the financial burden would look like.

The idea that only parts of the repository could be made reversible has not made its way into this report. This suggests that the central actor is now considering the aspect of reversibility based on the problematization of the government.

Regarding the waste, they recommend a classification of the waste based on IAEA and EU guidelines, in order to get a full account of the waste and its volume. Additionally, they mention that the packaging of the waste should be based on the chosen repository concept, which in turn could alter the volume of the total amount of waste. Other than this, no new significant changes are made in the problematization of the waste or the repository concepts.

The Betrayal

In this chapter, we will begin exploring the creation of the citizen groups and the early stages of the controversy of the Danish nuclear waste management as we know it today. We will depict the situation leading up to their founding and describe how they problematized the Danish nuclear waste problem.

The creation of the citizen groups (May, 2011)

The interessement device meant to enroll the geology in the translation, in succession of the feasibility studies of 2011, were the field studies of the selected six areas. To perform this interessement device, the municipalities had to be informed. Both in order to gain their consent to perform the field studies, but also as part of the desire to inform and involve all relevant and interested parties. This event is not covered by any reports published by the government or their allied experts (well, the field studies were, but not the public's reaction to them). Instead, we will use our empirical data consisting of interviews with members of the citizen groups and recordings of a hearing that occurred after the event.

The municipalities were, as mentioned, informed of the impending field studies. The municipalities and their mayors then informed their respective local newspapers, who then wrote articles about it. This was how the citizens local to potential sites were informed that their city might host a final repository for the Danish nuclear waste.

Here is how it was experienced by the representative of the citizen group leader of Struer municipality:

"Bendy: (...) The minister of health, they send out a letter to the municipalities, these six municipalities, saying that they were designated as municipalities for this waste. And then Struer municipality invited the inhabitants to [discuss] what we were going to do about it.

Interviewer: How did they do that?

Bendy: They, well, there was an ad in a paper. (...) We have something we call the [town]center, a community hall in Hvidbjerg, where we gathered quite a few [people]."

(Poulson, Interivew)

Curiously, as we follow the path of the information from the Ministry of Health to the citizens, we see that the Ministry only controls the contents and deliverance of the information from Ministry to municipality, but *not* from municipality to citizens.

Whether it was anticipated or not, the part of the public described as *local communities* materialized. The interessement device meant to enroll the geology, also created and interessed the local communities, but they were nowhere near being enrolled in their translation. Prior to this event, no information about the project had reached the members of the (about to be formed) citizen groups. All they knew was that they might host the final repository, which was really bad news for the neighbourhood.

"Bent: Well, we had read a bit about it in the local newspaper [Skive folkeblad] and then there were actually some people in Thise & Hvidbjerg, which are two small towns not that far away from Skive, who had come together and said that this didn't look too good, because they were aware that it could destroy a local community if they got stuff like that put in the ground in their backyard. We were completely unprepared and suddenly there were pointed out six locations. No one was involved in the process up until that point."

(Dyrberg, Interivew)

Their first reaction was to stop the efforts of the government building a final repository in their proximity. Not just because they did not like the idea, but because it could be a real threat to their livelihoods:

"Bendy: (...) It's not exactly a good advertisement for the area, and to make a living in these municipalities, we have to sell our food, our agriculture products, right? By the way, over there [pointing] where they wanted the final repository, there are some really large cornfields that sell malt barley for beer. It's exported to, among others, you [Copenhageners], and some other countries. If they get wind of a final repository under this earth, do you think the other countries would want this malt barley?

(Poulsen, Interivew)

The citizen groups have often been blamed for being motivated by Nimby. Their reaction might be closely related to concept of Nimby, but reducing the citizen groups to just Nimby is (to us, at least, and hopefully also to anyone who reads this) a misunderstanding of their situation. We would therefore use this opportunity to analyse the relation between this case and the traditional concept of Nimby.

Nimby

Nimby is an abbreviation for Not-In-My-Backyard, and is a concept that is often used in relation to criticize the local communities who live in proximity to proposed windmills, prisons, highways,

nuclear power plants and so on. In these cases, the "objects" that they are against having in their backyards are things that can be seen, heard, touched or even smelled, in some cases. Objects that interrupt or interfere (not to be confused with Mol's concept of interference) with everyday life by their proximity in some way or other (Kraft & Clary, 1991). The final repository is different, since it does not directly interfere with everyday life by its proximity to the locals in the same sense. It mostly does so psychologically, rather than physically. In an interview with the mayor of Skive¹⁶, shortly after it was announced that the municipality could potentially host a nuclear waste repository, he explains that even if it were to be put far down in the ground, it would still have a psychological effect on those living close by. That, no matter how safe the expert would claim it was, it would still instill a fear in the people living close to it. He then explained that, whether or not this fear was irrational was irrelevant. It had already affected the real estate market in the surrounding area of the proposed location, according to the Mayor of Skive.

Proximity to the final repository is therefore not just a question of not wanting to have it in one's' back yard. It is an actual threat to the local real estate market (admittedly a highway or a prison will also affect real estate prices, but the fear here is that the houses will become completely unsellable and create ghost towns around the locations) and the success of the local agriculture businesses.

Laymen becoming experts - The beginning of a counter translation

As our research progressed, we encountered a broad variety of main areas of expertise, concern and interest amongst our informants. During one interview, emphasis would be directed towards the preservation and protection of groundwater, whereas the next would focus on the matter of correct radiation categorizations, and half lifes of the waste.

The involved individuals often seemed to possess a somewhat specialized knowledge of a given field or topic, allowing them to contribute with examples and details that we had not previously encountered. This specialized knowledge also served to explain their relation to the nuclear waste management matter. More specifically, their feeling of obligation as to why their involvement was necessary.

"Bendy: (...) And then i felt like i was almost forced to sign up, because I am authorized to use radioactive isotopes to find holes in waterpipes (...). So I knew a little bit about the stuff, but it wasn't much."

¹⁶ <u>https://www.youtube.com/watch?v=W_LUPD784IQ</u> (TVSKIVE interview with the Mayor of Skive municipality)

(Poulsen, Interivew)

Bendy had previously worked at Risø as a blacksmith, and had professional knowledge of radioactive sources and their uses in plumbing. Bent who was one of the citizen group representatives from Skive, is professionally immersed in groundwater use. He could tell us about fluctuations in groundwater flow and its dynamic nature. And how, even in what is called "deep geological depths" there are large networks of groundwater deposits.

Bent: And then I'm thinking; "this sounds exciting", because I've always been very interested in groundwater, which is in my opinion the most important resource we have on earth, and at some point i think that water will become more expensive than oil. So i immediately thought to myself, that to bury stuff like this doesn't sound healthy."

(Dyrberg, Interivew)

It is our understanding, that the first few community meetings' main subject was simply; what is happening? They knew very little about the process to begin with. And since the government did not offer any information, they had to acquire it on their own. Thus, the problematization of the public were beginning to take shape.

Most of their knowledge were obtained by searching on the internet. They were all searching for nuclear waste solutions around the world, until they stumbled upon Holland's solution.

"Bendy: For this, I still use the freaking computer. You can find anything there, and then I found out that in Holland they do things very differently than we do at home, and it was strange that it hadn't been mentioned in all those huge piles of reports made by Risø, that you can make an intermediate storage facility - that THAT was a solution. So, I thought, I had to call and talk to them in Holland. So, I called them and they were very welcoming, so obviously, I asked them if I could come down and see it. Two days later, they had arranged an open house, so all I had to do was to show up. So, I had to call my wife and tell her to come home from work; we must go Holland! And then we drove to Holland the same night. And we had an incredible tour down there, and got a very good understanding of what intermediate storage is - which we didn't know much about. They were very open and honest."

(Poulsen, Interivew)

Reading articles on the internet is one thing, but seeing a solution with one's own eyes, being able to ask questions and so on, that is something else entirely. Bendy obviously told everyone else involved about the Holland solution, the intermediate storage solution. Why was this not a solution for

Denmark? Had it not even been considered, or had it been considered, and then dismissed? The only time it had been remotely considered before this, was during the 2005 mini hearing, where they considered and dismissed the idea of letting the waste remain on the facilities on Risø. Which helps to exemplify the contrast between the translations of the public and the government. The public were, and are, adamant that their solution is the right one.

Interestingly, most of the members of the citizen groups still do not consider themselves to be experts, even today. Six years after they got involved.

"Bent: But i would say, that i don't consider myself an expert in any way, but i have, well i guess i have used over 1000 hours on it. Gradually, a little has sunk in. "

(Dyrberg, Interivew)

They all say the same thing. Using the internet to find relevant information, on top of several trips to the facility in Holland, where the staff have been very helpful and educational. All of which is available to all other citizens of Denmark as well. The difference is their commitment, and their tenacity in actually doing the research, motivated by the threat to their community. Which has also been their greatest weapon.

"Bent: (...) I think that some of the officials, they underestimated partly that we bothered, and then some of them have been part of this for so long, that they didn't seriously realize, that we could use the internet for all sorts of exciting things. (...) That process could not be repeated, and I think some of them have had their eyes opened to that as well. They can't hide anything from us."

(Dyrberg, Interivew)

The public's problematization of the Danish nuclear waste problem

Just as the government began their problematization in 2001, so did the public ten years later, in 2011. The difference was, that, as we explained earlier, the individuals of the public had different knowledge of the subject, different expertise and different areas of interest. Some were more immersed in the geology, others, the waste. But just like the government, they combine their expertise and together, they formed a formidably thorough translation. Since the government had published their many reports on their websites, the public could compare their translation to that of the government.

Identification of the waste

One of the recurring topics regarding the waste, is the redefinition of the special waste. Basically, this boils down to whether the special waste is to be considered medium or highly active waste. There is no doubt of its longevity (on either side of the argument), it is long-lived waste. But, because the activity in the waste dictates how it can be disposed of, the activity of the special waste is obviously important to determine.

The methods used by the government to determine the special waste has been heavily criticized by the citizen groups, resulting in distrust in the integrity and competence of the experts, as well the involved officials.

"Jens: I will just say, that the redefined waste is regarding the 233 kilos spent fuel rods which are the most radioactive substance that exists in this context. And that is of course high level radioactive waste, but if you package it in a way that greatly increases the volume, then the average activity decreases correspondingly. In this country, it has been packaged in a way that increased the volume by a factor of 40 and thereby the average activity has been reduced by a factor of 40. And that is coincidentally just below the limit for medium to high active waste. We believe that is a scam, pure and simple."

(Albinus, Interivew)

Just as we have researched the nuclear waste management project, so did the public. They also found the mini hearing of 2005, and found it curious that there were discussed other long-lived radionuclides, which was not mentioned before or after this hearing.

"Jens: They can't get rid of the 233 kilos, and even if they could, it says in a mini hearing from 2005, they say the problem still isn't solved. We can't make a surface-near repository, because there are still long-lived mixed in with the short-lived."

(Albinus, Interivew)

They reached out to a professor, who had taught nuclear engineering at DTU (Denmark's Technical University), and who had been working at Risø since he was a young man. He was there when they packed many of the barrels of radioactive waste, that are now part of the problem. He told them that the rules were not very strict *back in the day*, and that the barrels have very mixed contents. These barrels with mixed and unknown contents are now known as the *historic* waste. The problem

with these barrels is that: "(...) there's the suspicion that some of those barrels of historic waste contain significantly more long-lived waste than DD will admit." (Anne & Jens, 2017)

To the citizens, it felt like the experts were withholding information. If they did not, then they did not know, which was just as bad. But the citizens were not in a position to do their own research, as in their own measurements and subsequent classification of the waste. All they were able to do, was to evaluate the information published by the government and their experts in regard to the waste.

"Bent: There are still many things that aren't solved. That's one of the things i don't understand. Like, they haven't figured out what they are going to with the 3000 tonnes of ore from, what's it called, the thing on Greenland.

Interviewer: Kvalefjæld

Bent: Kvalefjæld, right. And they haven't figured out what to do with the tailings. And i've never seen them."

(Dyrberg, Interivew)

This quotation is from an interview we performed in 2017. 16 years after they began the project, the government still have not decided on how to handle large parts of the waste. It made no sense to them, that the government were proposing several final repository concepts, that failed to include large parts of the waste.

"Bent: (...) So there are some things that will still be dangerous [after they are no longer radioactive], because there are all sorts of different toxic elements in it too. Like, there's lead and all kinds of other stuff and we've tried to find out what it is, but it's pretty hard."

(Dyrberg, Interivew)

Especially in regard to the cause of preserving the groundwater, the lack of attention to what happens after the period of 3- or 500 years was upsetting. It's all well and good to separate the radioactive waste from the environment, but part of the waste inventory also contains other non-radioactive toxic waste that is just as harmful to the groundwater and life in general. The citizen groups felt that this was an aspect that lacked concern in the government's problematization.

Identifying the geology - Earthquakes

As we mentioned in the previous chapter, the area called Thyholm was interesting geologically, due to its clay formation despite low tectonic activity. As the public began researching the report

published by GEUS in 2011, they learned that part of the reason why Risø was dismissed as a potential site was due to tectonic activity. This was strange to the inhabitants of Thyholm, since earthquakes are a regular event to them.

"Bendy: (...) One of the first things they said, was that it couldn't be built on Risø, because there was a fracture zone under it, you know, an earthquake fracture zone under Risø. There weren't any in the other areas. (...) You mean one of these? Said my wife. She was sitting in the couch when she could hear an earthquake from the North Sea. And just as we were about to start researching, we found that there was a giant fracture zone just under us.

(Poulsen, Interivew)

After a bit of research, they discovered that Thyholm is atop of a large fracture zone. This made no senses to the citizens of Thyholm. Why was Risø dismissed, when Thyholm was not? The citizens of Thyholm could not figure out, if GEUS thought they would not research the matter, or if it just did not matter if the facility would break apart, as long as it was far away from Copenhagen.

Interferences - Høfte 42

Another interesting aspect of the nuclear waste management issue, is that it draws in other seemingly unrelated matters that becomes part of the issue. For the inhabitants of Thyholm, Høfte 42 was a disaster that killed all marine life in the fjord, and caused a terrible stench in the surrounding area, making outside activities a dreary experience.

"Bendy: Well, it's actually a university, Aarhus university, who is responsible for the biggest environmental catastrophe in Denmark, just over there [pointing out the window]. Cheminova they have a factory over there that makes roundup poison, with 800-1000 employees. For many years, they drove their waste, they just drove it out into the sand dunes and poured it out into the sand. Then some old fishers over there were very against it, but what could they do against such a big company? He complained in the newspaper when he found dead birds and dead fish. But then at some point, all the lobsters in Limfjorden died, and that is something that is caught a lot of around here. And the fishers they figured it out quickly, because the lobsters are at the bottom, so they are among the first animals that die when there is poison in the water. It sets on the bottom, where the plant growth is. (...) and that fight has been going on ever since, and it still hasn't been cleaned up. It's still over there, encapsulated, they have put some barriers around the waste, so it's expected to be contained. But these barriers are just two iron plates they have pushed down in a track, there is no seal between the barriers, so water runs right through it. It's true - i think they have used 20-30

million on making it. But in reality, then it's probably just to satisfy the critics, not reality. And today the ocean has come so far inland, that it will probably just disappear into the ocean.

(Poulsen, Interivew)

The fact that the local chemical plant had obtained permission to dump their toxic waste by the government, created a general distrust in government for the inhabitants of Thyholm. Obviously, they were afraid of a repeat of Høfte 42. The similarities between Høfte 42 and the nuclear waste issue created a need for reassurance by the government. A guarantee that, if a leak were to happen, they would do something about it.

"Bendy: This is one of the reasons [Høfte 42] we don't want that to happen again, we don't want to be part of that. Because all the authorities they ran off, they didn't want to be part of it over there. Keminova was allowed by the county, and the old county and the municipality to drive it [the toxic waste] out into the sand dunes. They still have the paperwork today. So, it's not their problem, because they were allowed to do so. (...) And that's what we're afraid of with the nuclear waste -That they, when they bury it, then the government in 30, 40 or 50 years, will they run away and say they don't want anything to do with it? That's the thing, how do you get such a guarantee from the state? Is it even possible? Politics, it's unpredictable, isn't it?

(Poulsen, Interivew)

For the inhabitants of Thyholm, Høfte 42 is a strong reminder that governments can fail. As such, Høfte 42 creates distrust in the government and the experts even before they could be begin to attempt to enrol the public.

The intermediate storage solution

In a little under a year after GEUS had selected six areas (five municipalities, two areas are in Skive), citizen groups were officially founded in each of these areas.

They had lost all confidence in the authorities and the experts. The fact that the experts' identification of the waste and geology was so heavily flawed made them dread the notion of letting them bury the waste. It was the same dread that shaped their commitment. At this point, it should come as no surprise, that the citizen groups' translation was (and still is) based on an obligatory passage point that included dealing with the waste with an intermediate storage solution (Or, more precisely, anything that does not involve putting the waste in the ground. This just happens to be the only solution they know of with this criterion fulfilled). This was the only solution that made sense to them.

Bent: But it wasn't until I saw what they did in Holland that I said: This I am sure of, this is what we're going to do. I was absolutely sure.

(Dyrberg, Interivew)

They had seen the intermediate storage solution in action. The idea put them at ease. To be able to see the waste and the facility, to have it constantly under surveillance, in controlled conditions. A structure of reinforced concrete, able to withstand a plane crashing into it. And most important of all, time to come up with a better solution, without putting local groundwater and agriculture at risk.

"Bent: (...) It has been tried and tested, it works in other places [the intermediate storage solution], whereas an actual working final repository is nearly impossible to find anywhere. The attempts there have been, well, they haven't exactly worked out, one could say."

(Dyrberg, Interivew)

Merely the fact that the intermediate storage solution *works* is of great comfort to the citizen groups, opposite to all the failed attempts of building a final repository. One example is how Germany is now suffering the consequences of burying their waste in salt deposits:

"Bent: (...) And then I say, those Germans, they seemed to know what they were doing. Why did they think dumping it in salt deposits was a good idea? Where they are now trying to get it back up. It costs a billion every year, for the next 10-15 years. Then he [The vice director of COVRA in Holland] says; well, back then it wasn't such a bad idea, because when there's salt, there's no water, which means it's dry and you can put it there safely. The problem was then, that water currents down in those depths, they had apparently changed and then suddenly there were these overwhelming amounts of brine, eroding everything. So now the hope is they can retrieve it in time. Then he says: well, the Germans weren't that dumb at all, because all the rest of us, we just sailed out on the oceans and dumped it. And that's when I'm thinking; Okay, we can all see it today, it was completely idiotic. It may be 40 years ago, but I strongly doubt that we can make a solution that lasts for 300.000 years."

(Dyrberg, Interivew)

The consequences of wrongly depositing nuclear waste in the ground are not necessarily this severe. But the successful tales of disposing of nuclear waste are few and far apart.

Since the intermediate storage structure does not have any geographical requirements (at least not compared to the final repository), the siting process could look much different. The facility could create jobs and income in an area, which might actually turn the whole project into a good thing:

"Bent: I even think it could become a positive project if the process were volunteer based or something. I think that it could be a good idea to try and see if there were anyone willing to take it. I for one would be reluctant to sit and point at someone, because as we have stated, that is not our task, but one could imagine that there was someone in the country with knowledge of, maybe not this specific kind of waste, but knowledge of toxic waste for example, who would think; well, that is something we have some skills in dealing with, perhaps we could expand our existing dangerous waste industry. This is interesting to us because there are jobs and money involved in this, of course."

(Dyrberg, Interivew)

Instead of the government forcing a local community to take the nuclear waste, perhaps it could be turned into something positive. Instead of destroying the local real estate market, the facility could be placed in a dangerous-waste-industry-area, where it would be welcomed because of its ability to create highly paid jobs.

Another idea is to compensate the receiving municipality with something positive; to even out the negative of having to host a nuclear waste facility:

"Bendy: Well, as you can see, there is no one who would take on such burden without getting something in return. We have stated, here in Thyholm, that if they come here and want to build a university, then, hell, I would consider if I wouldn't rather have a university, and then I wouldn't mind the burden of an intermediate storage facility."

(Poulsen, Interivew)

Instead of having the geology as the common denominator for the siting process, the siting process could be turned into something positive, or at least something more constructive. Something that would turn the whole project upside down. A carrot had entered the playing field. It wasn't just the stick anymore.

This is what the intermediate storage solution is to the citizen groups. A solution that could handle the entirety of the waste inventory. A solution that sidesteps the distrust and perceived incompetence in the experts and the authorities. A solution that prevents future catastrophes as experienced in Germany. A solution that may turn the rather unpleasant idea of nuclear waste into something good. A solution they are certain will not fail. A "good" solution.

The domesticating efforts of the public (Gaining traction)

When we asked the representatives of the citizen groups about the early process, how they started and what they originally did to gain traction within the debate, one event was often referred to as essential: Their first trip to Risø, where they gave each other the "musketeer oath"

"Bent: First of, one of the smartest things we did early on was to join up with the others. (...) It was there [at Risø], that we gave each other the musketeer oath. We didn't know each other at that time, but now we all know each other well"

(Dyrberg, Interivew)

All of the representatives agreed that much of their success was a result of the musketeer oath. During an interview with a representative of one of the citizen groups, this was even expressed to us as one of the most important things they did.

"Bent: Well, i think that what we benefitted the most from, were to meet the other citizen groups and that we gave each other the musketeer oath and said "we want to do this together", and that is also what the politicians says. I think it took the government officials by surprise that we joined forces. I think that they expected us to fight against each other. "We don't want it! you have to take it!", sitting there, pointing fingers at each other and so on. We didn't do that, we joined up and said "none of us wants it and it is not a matter of who should take it, it's a matter of not burying it. It was a different agenda than the one they had planned. I think that threw them of a little. That was probably what we benefitted the most from"

(Dyrberg, Interivew)

It was considered a clever move in which they had managed to get the better of the government's scheme to pit them against each other. An event by which the citizen groups had managed to enroll one another and establish a common goal: to stop the government's plans of burying the nuclear waste.

This signifies what we have found to be a clear display of the citizen groups' translation process. Their first step in an organized effort to change the plans of the final repository.

The other public representatives

Important to mention is, that apart from the citizen groups, a few other individuals are also active in the case. These individuals fall outside of the government's identification of the public as consisting of NGO's and local communities. They were neither part of an NGO nor were they local to any of the proposed sites for the final repository. A more precise description would be *concerned* or *interested citizens*. Even though they were not a part of the citizen groups, we still experienced these actors as relatively similar, based on their problematization. Please welcome Anne and Jens (to the translation of the citizen groups).

"Bendy: Everything that we protest and refuse has to be something that we can prove. We won't just refuse because it looks bad in our backyards. So, we've actually read tons of reports about nuclear waste. You can ask Anne, it's her and Jens who are doing the most, because they're good at finding, organizing and archiving so we can retrieve it when we need to.

(Poulsen, Interivew)

Their problematizations were alike, but their methods and their involvement was different due to their relation to the case. Since they were not in proximity to any of the proposed sites, they could not be accused of being motivated by Nimby related causes, which also means that they did not have a neighborhood at stake either. Instead, they were purely motivated by a distrust in the government's plans. This explains why they have a more radical and less constructive approach.

"...They don't want to be a pain in the ass and that's why they are probably happy that i can play that part."

(Albinus, Interivew)

These *concerned citizens* operate more like a supervisory entity, one that scrutinizes and judges every single detail of the government's plans. An approach that is radically different to that of the citizen groups. The citizen groups' attempts to interesse the government by suggesting an alternative solution, while the concerned public criticize the government's flawed plans, indirectly contributes to the notion of an alternative solution by proving theirs' is wrong. As such, the citizen groups would be able to remain in a more diplomatic position of relative constructivity while the concerned public have a more radical and judgmental approach. Either way, due to their successful collaboration and because their problematizations are so similar, we consider these particular concerned citizens as part of the citizen groups.

The alliances of the citizen groups

Besides the alliance with other concerned citizens, the citizens attempted to forge alliances with another part of the public - the NGOs. There are currently three NGOs involved with the Danish nuclear waste problem: NOAH, friends of the earth Denmark, Greenpeace and Danmarks Naturfredningsforening¹⁷. Before we go into their relation to the problem and the nature of their alliances with the citizen groups, we will briefly describe their organizational structure.

Danmarks Naturfredningsforening

Dansk Naturfredningsforening have chosen not to express an official opinion other than a wish to find the best possible solution. This decision was mostly due to their organizational structure. Unlike most other NGOs that we have encountered, DN used in-house experts. Engaging in a complex topic like nuclear waste (which is atypical for Denmark, since there are practically no nuclear activities any longer) would require substantial allocation of resources:

"Sine: At the same time, we do not have a history of working with nuclear waste because we do not have nuclear power in Denmark. So, it hasn't been a field in which we have built up any expertise. So, we ask ourselves, is this something that we want to prioritize? To put a lot of resources into knowing a lot about this stuff? Or do we assume a low profile and say that this is something that we expect that the authorities and the ministry is able to solve in a proper manner."

(Fauerby, Interivew)

For now, their strategy is to follow the progress, and hope that government will come up with a reasonable plan.

They are the largest NGO in Denmark, with satellite offices all over the country:

"Sine: Well, it's a case where we've had to keep a pretty low profile. Because we realized that it could easily become something that our locals [satellite office volunteers] could become quite involved in in relation to how none of the municipalities want this (...). So it could quickly become an internal struggle, and should we then go out and pick a place to put it [a repository], thus screwing over one of our local departments? We weren't really interested in that."

(Fauerby, Interivew)

¹⁷ Denmark's nature conservation union. DN for short.

If DN was to commit to the cause of the citizen groups, they would have been a formidable ally based both on their resources and their reputation.

"(...)we may be a little sad that DN won't take a stance. But that's their choice, we will have to respect that. We will have to say, well fine, and then act accordingly."

(Dyrberg, Interivew)

NOAH, friends of the earth Denmark

NOAH is probably the NGO who was the closest ally to the citizen groups for a long time. After a few years of effective cooperation, they parted ways due to a difference of opinion. Their problematization were just not similar enough anymore.

NOAH's contribution to the nuclear waste problem is based on the one-man army, Niels Henrik Hooge (a very dedicated army, however). Compared to DN, NOAH has almost no available resources other than the time the volunteers want to donate.

"Niels: The activities of NOAH are volunteer-based and it's not like I'm here very often, I only came to talk you two. When you leave this place so will I. But, as I said, since 2011 I have been involved in the campaign for the nuclear waste.

(Hooge, Interivew)

Most of the firepower behind NOAH are thanks to the connections they have. In the case of the nuclear waste problem, it was NOAH reaching out to the international expert on nuclear waste Gerhard Schmidt that put NOAH on the map. The combined efforts of NOAH and Gerhard Schmidt have had great impact on the government's process:

"Niels: He's the one [Gerhard Schmidt] that, maybe more than anyone else, criticized the final repository concept. Him and the Öko-institute's work papers may be one of the main reasons why they now discuss intermediate storage and a deep geological final repository (...). It could very well end up being intermediate storage followed up by a deep geological repository in many years. And that is thanks to his efforts, one could say.

(Hooge, Interivew)

We were told how the involvement of Gerhard Schmidt originally had been a cooperative effort in which the citizen groups had partaken. However, when they realized that the recommendations would include a deep geological repository, they backed out. The citizen groups expressed how they

had found it ridiculous that a recommendation would include burying the waste, since that was one of their main objections from the beginning.

Niels explains how, from his point of view, the citizen group's refusal of Gerhard Schmidt recommendations was because of Nimby related reasons:

"They always take their point of departure in, not in my backyard. And i am not saying that they do not consider what's best for the country, however, it isn't their first priority and it isn't there their strength lies. And so, they have a very strained relation to Gerhard Smith. There's a separating line there. If you want to know what the difference between a citizen group or a citizen initiative, and an environmental organization is, then you have a pretty good indication right there. There have been some friction and stuff like that between us, but it is not so bad that we wouldn't be able to work together on the things we agree upon."

(Hooge, Interivew)

The cause of this shift was described to us as a result of how the NGOs operates. It seemed the impression here was that the way in which the NGOs operated, relied too heavily on the recommendation of one person. Which really is not that far off, from how they operate:

"Niels: Well, NOAH isn't experts on fields such as these. We run campaigns and then we rely on experts, the confirmed experts whom we trust. There aren't many of those in Denmark."

(Hooge, Interivew)

Part of the criticism of the NGOs is also based on the motivation of their involvement. Obviously, NGOs must have some sort of income, as a result of their campaigns. Their reputations are equally important. To be an environmental NGO, it's pretty much required to fight for the right solutions. Nevertheless, to the citizen groups (and the concerned citizen), they found NOAH to be too concerned with appearances:

"Anne: A lot of it has to do with their profiling and all that. That's what we have seen. There is a lot of money involved. Because the environmental organizations have to promote themselves and collect money for projects so that people can see that the exist."

(Albinus, Interivew)

The difference between the problematization of the citizen groups and NOAH resulted in an end to their collaborations. Again, the difference between their problematizations may be explained by their relation to the problem and their strategy.

Greenpeace

Representing Greenpeace in Denmark we find a single person, Tarjei Haaland. Tarjei has been actively protesting anything nuclear related in Denmark since the 70s, where Danish utility companies interest in building power plants sparked his interest in the subject.

Greenpeace have been steadfast in their problematization since they were involved in 2001. Which is longer than, well, pretty much everyone. Their solution to the problem is to build a retrievable near-surface repository in the vicinity of Risø.

"Tarjei: The government in effect before 2001 wanted to start out by involving some NGOs since they contacted me. (...) Back then it was called a final repository, and what we argued was that it had to be a final repository that would be retrievable, so the waste could be taken back up and that is why it should be surface-near. And in principal that is the same as intermediate storage. (...) I think that you might as well realise that the most suitable place would be where most of the waste is already. They have been used to having the waste there in a quite dreadful way, like an open dump for many years, right? But you could also go a little in-land where there is a little high terrain and find a place to put it there. And create what is an intermediate storage facility there. (...) We said it could be a fine ending to make such an intermediate storage facility, a final repository-intermediate storage facility on the surface close to Risø."

(Haaland, Interivew)

They believe that, since the communities local to Risø are accustomed to the nuclear activities of the past 50 years, they will be more inclined than anyone else to accept living close to it. Additionally, by placing it close to Risø, transport of the waste is not necessary. Tarjei is very concerned with the issue of transportation and the accidents that may happen during transit.

His problematization of the issue is similar to that of the citizen groups, although he is in favor of a version of the final repository. The distinction between a final repository and an intermediate storage solution is blurred by the retrievability feature.

Even though they have such familiar problematizations, the relationship is strained by an unfortunate event. Tarjei ran a campaign on Bornholm to collect money for his campaign to protest having the nuclear waste buried on Bornholm. He did so, without contacting BOMA, which is the citizen group against nuclear waste on Bornholm: "Bent: When they first started on Bornholm they did it without contact to BOMA, all of a sudden. They ran a campaign and collected money around Bornholm to be able to say no to nuclear waste on Bornholm. I don't think that's fair.

Interviewer: Collecting money for themselves?

Bent: Yes, for Greenpeace. I think it would have been fair to say, okay BOMA, we know you are there because we have had contact several times. Should we do something together. I think that would have been the right way to do it. (...) I wouldn't say that we are pushing them away, we do talk to them, but they have their agenda, and we have ours. So, in this way there is a little distance between us."

(Dyrberg, Interivew)

The citizens attempt to strengthen their translation by enrolling the NGOs have been less than successful. There has been some cooperation that led to good things, but the relationships between citizen groups and NGOs were a little precarious at the time of our investigation. One thing is certain, however. Their problematization are not aligned. They are not fighting for the same cause. The public is therefore somewhat fragmented, which also proves that having NGOs representing the local communities does not reflect the actual situation.

Børsen

In October 2012, the mayors of the five municipalities and the citizen groups arranged a hearing at Børsen¹⁸ in Copenhagen. The hearing had several purposes, but most of all, it was arranged to protest the government's plans of building a final repository, and to present a different solution to the nuclear waste problem - the intermediate storage solution.

They had invited all relevant experts, the Minister of health, Astrid Krag, politicians and reporters. Many of which attended the hearing, most notably of which was Astrid Krag. Unfortunately, her performance at this hearing was less than successful in enrolling, well, anyone, in the translation of the government. Quite the opposite happened. Many of the other attendees found her behavior to be insulting and deceitful, as if she was withholding information.

We asked all our interviewees what the cause was for their commitment. Most of them answered that it was first and foremost the siting process that selected the six locations. But the event that really made them commit, and to realize the importance of their commitment, was the hearing at Børsen:

"Jens: (...) but what really made an impact was the hearing we attended, was it October [20]12?

Anne: At the stock market [Børsen]

Jens: Where the previous health minister, who was in charge, Astrid Krag, she made a presentation and then ran off, because she had no interest in answering questions from the room. Although it was a meeting arranged by the mayors of the five municipalities, so it was actually, well, just a small thing, right. And it was there i became aware that there was something that needed to be sneaked through, somehow."

(Albinus, Interivew)

At the end of Astrid Krag's 20-minute speech, she excused herself, explaining that she did not have time to stick around for questions. Although, she answered a few of the moderator's questions, but took no questions from the audience. She was just about to leave, when two citizen group representatives stood up with their hands full of sheets of paper with signatures, and moved towards her podium. The representatives then put the signatures on the table. She begins to walk around the room, clearly looking for someone, then returns to her podium and says: *"I know i'm the*

¹⁸ A historic building close to Christianborg, the Danish Parliament

Minister of health and we care about exercise and stuff, but i will probably need some stronger souls to carry it out of here." And then she leaves. (Børsen hearing, 2012)

The citizen groups could not believe it. All their hard work of getting all these signatures, for her to just make a short remark, and then walk away.

"Bodil: We handed over about 55.000 signatures from the citizen groups, that stated, that we wouldn't accept burying the waste. Astrid Krag wouldn't even look at them.

(Waagesen, Interivew)

Appalled by her reaction, the citizen groups were in a state of disbelief. Negotiating with the ministry of health was not an option. A different approach was needed.

"We started by collecting, i don't remember the number, somewhere in between 53 and 57 thousand signatures and handed them over to the Minister at that time. But we could hardly get her to accept them. She almost just walked away. That was when we realized that this approach wouldn't work."

(Dyrberg, Interivew)

The interaction with the Minister of health added to the distrust and the general low opinion of the government and their plans. If her speech even had the intention of enrolling the attendees of the hearing to the cause of the government, it certainly did *not* have that effect. Instead they became even more motivated to stop their plans, by the confirmation of the incompetent and shady nature of the people involved.

It was made clear to us by the citizen groups that they were aware of the term *Nimby* and that they strived not to fall under this category. We experienced a general negativity towards this term as it seemed to represent a somewhat invalid argument. They certainly did not want to be identified as a group obstinately against living in close proximity to the nuclear waste facility. There was so much more to them. They did not want the waste to be put in the ground anywhere in Denmark, regardless of how deep and how "safe" it was.

It was expressed to us during one of our interviews with a representative from a citizen group, how they early on decided to approach the issue in a constructive manner.

"Bent: In the beginning, we were pretty idealistic about it. "We will start a public rebellion" and so on, however, we would do it in positive manner. We have actually been called "the positive protest
movement". We didn't just say, "we don't want it", sat down and crossed our arms. We are well aware that the waste exists, we just need to figure out what to do with it."

(Dyrberg, Interivew)

Merely protesting the government's proposed plans was insufficient. By proposing a different solution, one that did not involve putting the waste in the ground, they would have more firepower compared to just saying no. The Børsen hearing confirmed that this strategy would have little to no effect. The handing over of the signatures signifies the last attempt of the strategy of just saying no.

The citizen groups had now ruled out negotiating with the government, based on the events that transpired during the hearing at Børsen. Luckily, they came prepared. There was still the option of trying to convince members of Parliament to open up to the solution of intermediate storage, instead of disposal through a final repository.

Shortly after Astrid Krag's speech, the two representatives who handed over the signatures gave a presentation. The presentation alternated between the disadvantages of burying the waste, and the advantages of the Dutch intermediate storage solution.

When describing the process of establishing themselves as a worthy participant within the debate, a representative from one of the citizen groups stated the following:

"Bent: It has taken a very long time. However, if we are to look at the bright sides of the process, we were actually able to get the politicians to listen to us. (...) But it has required some work, I must say. We have been travelling around to attend public meetings and at one point, we began to seek out the politicians at Christiansborg. We decided in the moment who were the most interesting for us to meet with and went to talk to them directly."

(Dyrberg, Interivew)

The citizen groups' efforts of trying to convince the politicians of Parliament eventually came to fruition. Roughly four months after the hearing at Børsen, the 22. of January 2013, the Minister of health Astrid Krag announces that the government will now investigate the option of intermediate storage. On the 21. of November 2012, she had had a meeting with the political parties of Parliament, to discuss how to proceed with the management of the nuclear waste. The parties agreed that, whilst investigating the final repository solution and the exportation options of the 233 kilos special waste, they should simultaneously investigate the option of intermediate storage. (Sum, 2013)

The citizen groups now knew which strategies worked. They had successfully interessed Parliament in their translation.

From Ministry of health to UFM

To say that the Ministry of health had mismanaged the process, would be to put it mildly. Luckily for them, the responsibility of the nuclear waste was transferred to the Ministry of research and education (UFM) in 2015. Apparently, the Ministry of health had wanted change in the organisational structure for a long time:

"Kristoffer: What happened was... Well, the Ministry of health have always been really sad about having this case. Originally the situation was, that we [UFM] had the special waste since we were the ministry responsible for research center Risø. So, the special waste with the irradiated test fuel has always been our responsibility. And then all the rest of the radioactive waste from the decommissioning and the hospitals and lots of other stuff, was the responsibility of the Ministry of health. They were really sad about it, because as they said, it is tough for us to both be the professional authority who has to make suggestions as to how to regulate this area, meanwhile also having supervisory duties. Because, you can't be both legislator and judge within the same organisation. So, they were very very sad about this, and wanted a separation of their functions so they would only have the supervisory duties as their responsibility. And that is why they have been complaining for years. But after the election of 2015, they said: "Okay, we're going to pack up and move the responsibility for the entirety of the waste over to UFM, so that they are not only responsible for the special waste, but all of it. This is how the clear distinction between supervisory authority and regulatory authority was made, and the reason for it.

(Bertelsen, Interivew)

They were never meant to play the role that they ended up playing. They never wanted it.

"Kristoffer: (...) So when they finished writing the basis for decision for a final repository, they could pull out and say: Okay, we have now delivered the legal basis, now everyone knows what rules are in play, so we will check-out and say bye-bye, so now you have to find someone else to do the rest. That just didn't happen, and that is why they have been so furious, so distraught that for seven to eight years, they were still on the hook for it, until they were relieve of it in 2015. So, that may help explain the way it was handled.

(Bertelsen, Interivew)

Kristoffer explains how the Ministry of health had insufficient time allotted to deal with this highly complicated matter. That, what we see is not necessarily an individual who is not competent enough

for her job, but the result of a ministry whose distribution of time and resources is off, who clearly does not prioritize this issue. A ministry who is *just not that into it*.

But that does not change the mess that was left for UFM to clean up. The process had been thoroughly derailed. There was no negotiating with public. And especially no win-win situations in sight.

"Kristoffer: Exactly, and then that hearing, where she just gets up, makes her speech and then walks out. That's a little "aargh" [he exclaims], her spin doctors must have simply torn their hair out in great big clumps, because that's just such a "no-go". That's a surefire way to derail a discussion. So, we've obviously looked into that and hopefully learned something from it in regard to the procedural efforts.

(Bertelsen, Interivew)

Kristoffer is the chief consultant and the person in charge of the government's effort of disposing of the Danish nuclear waste. He is also an anthropologist, who emphasizes process. Different from how it was managed by the Ministry of health, the project was now run by a person dedicated to this issue, and not by a minister who has a myriad of other responsibilities. A dedicated person with knowledge of processes and cultures, no less.

In other words, 2015 brought with it a radical change in the structure of the actors central for the final repository translation. Thus, the new central actor created a much different problematization of the Danish nuclear waste problem.

Contact forum

One of the first major acts of the new Ministry in charge, was to establish a contact forum. The purpose of the contact forum is to include all relevant and interested stakeholders in a constructive setting, as a communicative tool to ensure everyone was heard, and to let everyone know what was going on. But before such an interessement device can be taken into effect, an investigation of who to involve must take place.

"That it is ensured, that the central stakeholders in the case are identified and invited to participate and contribute in the discussions that occur prior to the political decision process. Our experience is that it is advantageous to set aside plenty of time to identify the different stakeholders of a case, by asking around in the networks and the more formal structures that are part of a case. It is important to analyse who is part of the case both formally and informally. It is also important to analyse how

the stakeholders can be expected to contribute to the process, so the dialogue can be shaped to fit the individual stakeholders' role."

(Bertelsen, E-mail)

It is apparent by Kristoffer's phrasing, that he is familiar with the theoretical framework of the social sciences. Nevertheless, the process of identifying the relevant and interested stakeholders of the case, can be seen as an example of how the central actor initiated their own problematization, instead of continuing with the translation of the previous ministry in charge. And, luckily, since the citizen groups are well established at this point with their own appointed representatives, no active mobilization efforts were necessary.

As we have explained earlier, the deciding actor of the case is Parliament. The task at hand for the government is to create a plan that Parliament will pass. As such, the contact forum's purpose is not only to enroll the public, but also to identify the conflicts of the case in order to create a better basis for decision:

First of all, stakeholder involvement as a public authority is about gaining access to information and opinions that can contribute to making a basis for decision more robust. And by robust, I mean that a process have been completed, which creates clarity on which conflicts is part of a case, and how these conflicts can be incorporated in the basis for decision and in the design of a proposed solution. The purpose is to find out, 1) which conflicts that are possible to resolve without compromising the case, and 2) which conflicts that are so substantial, that they cannot be resolved with stakeholder involvement, but must be mediated in a continued process, where they may be resolved by political negotiations.

(Bertelsen, E-mail)

To that effect, participating in the contact forum does not grant the participants sway over the decisions to be made by Parliament. No political representatives participate in the contact forum. The participants consist only of representatives of the technical and social aspects relevant to the case (and procedural representatives, if you count the obvious representatives from the Ministry). Participation in the contact forum, however, does not *prevent* influencing the political decision-making process outside of the contact forum.

"That the dialogue with the citizen is designed in a way, that creates complete transparency of the framework of the dialogue in the beginning of the involvement process. It must be made clear, when the case is moving from one phase to the next, that there are boundaries of stakeholder involvement regarding the political process of the case, both within and outside of Parliament. It is of paramount

importance to make clear to the stakeholders, that there will come a time, where the case will move into a political negotiation arena, which is not open to the public. Citizen may of course affect this political negotiation arena by contacting politicians, campaigns, letters etc., but it is not the purpose of the stakeholder involvement to provide a platform for this type of activity (because stakeholder involvement must describe opinions, not argue for them)"

(Bertelsen, E-mail)

Other relevant stakeholders, like international experts, were invited to participate in the meetings by request of the participants who fall under the category *the public*.

It is no secret, that the contact forum is an interessement device meant to enroll the public (both NGO's and local communities/citizen groups), by creating a forum in which the Danish nuclear waste problem can be discussed and negotiated among all relevant parties. Well, except for the members of Parliament. But as Kristoffer explains, he expects the contact forum to continue until the nuclear waste problem has been resolved. There might be some changes in the composition of the participants when (and if) a new siting process will be initiated, but except for that, Kristoffer explaing the contact forum. This inclination toward the contact forum regarding the enrolment of the local communities, shows an understanding of the mobilization issues of the public. While the negotiations and the information shared by the current representatives of the local communities may be somewhat close to reality, Kristoffer acknowledges that this mobilization does not (necessarily) represent the local communities may be an insurmountable challenge, but also that they do not necessarily represent the local communities that need to be enrolled. Nevertheless, the information shared by the citizen groups and the NGO's is valuable to the government if they are to avoid the same issues from happening in future siting processes.

The government's version of intermediate storage

Since the government was now also investigating the intermediate storage solution, there now existed two different problematizations in which it was part. And since these two central actors problematized the situation differently, the intermediate storage solution was enacted in two different ways. To compare the differences of these two enactments in the next chapter, we will describe how the intermediate storage solution was included in the government's problematization.

First of all, the government is very concerned with what happens after the intermediate storage period has passed. Just because the intermediate storage solution is part of the plan, does not mean

that the problem has been resolved. Plans for disposal of the waste must always be part of the strategy, especially if the nation has the skills and resources to do so:

"Kristoffer: (...) So it's an impossible task to intermediately store something, that you don't know what will happen to in the end. You'd have to be technological optimist to think: "well, the scientists will take care of it, they will make some sort of solution so we can suddenly sprinkle some fairy dust on the waste. Now it will disappear and won't be dangerous anymore." And that's just not how it works with nuclear safety, you know? That would be considered as leaving the problem for the future generations to handle. Because the ethics in this is, that if u can create a solution that meets the safety requirements, then it has to be done, as soon as possible."

(Bertelsen, Interivew)

To leave the planning of the disposal method until a later time is not an option. In other words, plans for a final repository will always be part of their problematization, the specifications of which will have great impact on the practical design and operation of the intermediate storage facility:

"Kristoffer: Well, you know, we have to have an idea about what we're intermediately storing towards. If we are to continue the operations organization on Risø or wherever the intermediate storage facility may be placed, they have to know; how do we package the waste? What kinds of containers to choose? And a bunch of other practical things, like how to characterize the waste, that is quite an important detail. And as I said earlier, if the short-lived and the long-lived waste is thoroughly mixed together in some of the barrels, there are over 5300 barrels out there, then we have to get a complete account of what is mixed together and how much we are dealing with. And that task is defined by which kind of solution or concept you are working towards. Because if you choose to characterize it in a certain way, then that permits a sorting of the waste, or a categorization, which means that you have to be certain you're doing it the right way. So, you have to know what final repository concept it is and how the barriers are constructed. That means, for example, that the long-lived waste from the spent fuel, it has to be handled in a specific way during the intermediate storage period to be packaged for final disposal.

The reason why the government is required to include the plans of a final repository is part the *ethics of not burdening future generations,* part EU directives¹⁹. Article 21 of the EURATOM

¹⁹Article (21) Radioactive waste, including spent fuel considered as waste, requires containment and isolation from humans and the living environment over the long term. Its specific nature, namely that it contains radionuclides, requires arrangements to protect human health and the environment against dangers arising from ionizing radiation, including disposal in appropriate facilities as the end location point. The storage of radioactive waste, including long-term storage, is an interim solution, but not an alternative to disposal. The typical disposal

directives requires member states to include a plan for disposal in their strategy. It should be mentioned, that this article went into effect in 2011, and was therefore not part of the problematization of the previous ministry.

"Kristoffer: You may as well grab the bull by the horns and say: well, there will be a disposal facility, a final repository, because that's what we have to do, that is EU nuclear waste directives in a nutshell. There is no discussing it.

Even the Dutch with their intermediate storage facility have declared: "We are intermediately storing to make a deep geological final repository which we will establish in the period 2100 to 2130." And that is what they are researching now, to find the best possible location and so on, in Holland. So it's just... If it's the Dutch intermediate storage solution that is the goal for some people, then that's fine, but they have to realize that it still includes a final repository in the end, without which Holland never would have gotten permission internationally."

(Bertelsen, Interivew)

The intermediate storage solution they have in Holland is only possible due to their specific situation of having to decommission a large nuclear power plant in about 30 years. The situation in Denmark is much different. As we previously mentioned, the decommissioning of Risø marked the end of *all* nuclear activities in Denmark:

"Kristoffer: (...) Holland has good reason to wait this long because they actually have something still in operation, a power plant in operation. This is not the situation in Denmark, at all. Soon, on the contrary, we will have nothing in operation or to be decommissioned at all, or anything that can be characterised as a nuclear facility. The only nuclear facility that exists in Denmark is the treatment station on Risø. Everything else is over and out.

(Bertelsen, interview)

concept for low and intermediate-level waste is near-surface disposal. 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 spent fuel considered as waste. Member States, while retaining responsibility for their respective policies in respect of the management of their spent fuel and low, intermediate or high-level radioactive waste, should include planning and implementation of disposal options in their national policies. Since the implementation and development of a disposal facility will take place over many decades, many programmes recognize the necessity of remaining flexible and adaptable, e.g. in order to incorporate new knowledge about site conditions or the possible evolution of the disposal system. The activities conducted under the Implementing Geological Disposal of Radioactive Waste Technology Platform (IGD-TP) could facilitate access to expertise and technology in this respect. To that end, reversibility and retrievability as operating and design criteria may be used to guide the technical development of a disposal system. However, those criteria should not be a substitute for a well designed disposal facility that has a defensible basis for closure. A compromise is needed as the management of radioactive waste and spent fuel is based on state-of-the-art science and technology. (2011)

If the EU were to permit Denmark to include intermediate storage of the waste, then a good reason would be required. Presently, the government has no suggestions as to what that reason could be.

Timeline

We have now covered the highlights of the period 2001 until 2017. We hope you got through okay. To help keep track of all the events we have described, we would like to provide you with a timeline. And perhaps suggest a coffee break.



3 TIMELINE

Sites and options

We have now described the two main problematizations of the Danish nuclear waste problem. In this chapter, we will analyze the sites used by the two central actors to make their choice of option.

Where are the options?

If we consider the beginning of the government's translation, we can define the first site that lead them to the choice of the final repository. During the deliberations of B48, they argued: "*We have to clean up after ourselves. We can't pass this mess onto our children. [future generations].*"(FT, 2003, stated by almost all party representatives) To do so, the only obvious solution was to create a final repository. The alternative would be to do nothing. To let it stay at Risø and let the future generations dispose of the waste.

Curiously, the final repository solutions proposed in 2003, was not limited to underground solutions. The bunker solution is an aboveground solution. Nevertheless, the bunker solution was not part of the proposed solutions in 2005. As of 2005, final repositories were exclusively underground solutions. The only difference was the depths for which the waste should be buried.

Fast forward to 2011: Enter the citizen groups and their solution, intermediate storage. And as they convinced Parliament to have the government investigate their solution, the sites in which their choice was based changed.

To choose between the options of intermediate storage or a final repository, a new site emerged. Consider the statement by Kristoffer from the previous chapter: *"Because the ethics in this is, that if u can create a solution that meets the safety requirements, then it has to be done, as soon as possible.²⁰" (Bertelsen, Interview)*

The words "can create" suggests a site based on a trust in the ability of the experts to design and construct the actual facility to dispose of the waste (we are aware that he is referring to an underground repository's safety requirements and that we might stretch the following argument a bit. We will make up for at the end of the argument). First of all, whether or not the options dispose of the waste, is based on how they affect future generations. This site may seem even more moot, since if the experts possess the ability to create a final repository that meets the safety requirements, they will also be able to create an intermediate storage facility (not to mention that we already have an intermediate storage facility at Risø, that currently stores all the waste). And

²⁰ Trust in experts to dispose in the figure

since Kristoffer believes that the experts possess the ability to construct the facility, no choice can be made at this site. The site that defines the government's choice is therefore pushed onto another site, or rather, back to the site of *cleaning up ourselves, and not passing the problem onto our children*. Making a choice based on this site, means choosing the option that does not *pass the problem onto our children* (which is the same as *not burdening future generations,* it's just not the same phrasing as Parliament's).

This raises a new issue, because both options pass problems onto our children. The final repository has an inherent risk failing as seen by the German example. Retrievability may alleviate some of the risks involved with a final repository, but it also represents another problem for the children of tomorrow; if (and that may be a big "if", but it is there, nevertheless) they ever needed to retrieve the waste, then they would be required to create a new solution to dispose of the nuclear waste. Not to mention the retrieval of the waste itself, which might expose them to dangerous ionizing effects if they do not possess the right expertise to do it safely.

Kristoffer argued that the intermediate storage solution does not solve the issue, since it does not dispose of the waste - that intermediate storage is, as the name suggests, a solution between solutions. Which means to intermediately store the waste is the same passing on the problem of disposing the waste to our children. Since they will be the ones to create the future final repository. This leads us right back to the site of *trust in the ability of the experts to design and construct the actual facility to dispose of the waste* (to reiterate: since it does not dispose of the waste). In other words, the choice of option based on the sites relevant to the government is the final repository.

The citizen groups' translation, as you might have guessed, leads to a very different set of sites. They also all lead to the same site. We will therefore take a different approach in how to present the sites of the citizen groups compared to the government. Instead of walking through the sites until the we get to the final site in which the final choice is made, we will begin with a single site and explain how the choice based on that site is the same for all the other sites.

If we consider the severe distrust the citizen groups have in the experts as the first site, the choice is obvious: by not burying the waste, trust in the experts is not necessary. Burying the waste requires trust in the experts' ability to construct a facility that is guaranteed not to fail in a period of 3-500 years (minimum). The site is exactly the same as the government's site; *the ability of experts to design and construct the actual facility to dispose of the waste*". The option of not burying the waste is also the choice of all the other sites relevant to the citizen groups: The site of groundwater contamination, interferences such as Høfte 42, the effect on agriculture and real estate and last, but

certainly not least, the site of *not burdening future generations*. By not burying the waste, future generations are not in danger of catastrophe due to a faulty underground final repository facility.

Notice how we chose to phrase the options as whether or not to bury the waste. And, as proven by the choices, no sites point to the need for *intermediate* storage (as in a solution in between solutions). They only point to disposal of the waste with an aboveground solution.

Now, for the sake of argument, let's do an experiment. Let's consider the sites proposed by the government, but switch out the option of *intermediate storage* with *aboveground disposal*. Let's imagine that, instead of the citizen groups convincing Parliament to investigate the intermediate storage solution, they had convinced them to investigate aboveground disposal solution. If we consider the site; *trust in the ability of the experts to design and construct the actual facility to dispose of the waste*, and how Kristoffer trusts the ability of the experts to construct the underground repository facility, we must assume that this applies to an aboveground repository facility as well (we think it's fair to assume that an aboveground repository is less challenging to build compared to an underground one). And if both solutions dispose of the waste, there should be nothing in the way of the government to choose the aboveground reposition option. Except they are not the ones to choose between these options. The choice has already been made for them by the EU, with article 21.

Where is *the* option?

The negotiations between the government and the citizen groups are at a bit of a stalemate. They are both steadfast in their convictions, with no resolution in sight. The options are quite black and white; A final repository or intermediate storage (without actually intermediately storing towards a specific goal. To clarify, by intermediate storage they mean above ground storage). With this chapter, we wish to dig deeper into why these actors have chosen their respective options.

As we previously explained, the government is bound by the EURATOM article 21, which requires member states to dispose of the waste by means of a final repository for low to medium level waste. But they are also bound by article 24 which states:

"(24) It should be an ethical obligation of each Member State to avoid any undue burden on future generations in respect of spent fuel and radioactive waste including any radioactive waste expected from decommissioning of existing nuclear installations. Through the implementation of this Directive

Member States will have demonstrated that they have taken reasonable steps to ensure that that objective is met."

(EURATOM, 2011)

The government's interpretation of article 24 is based partly on an assurance of the institutional safety requirements and that a system is needed to provide future generations with the tools to supervise the final repository facility. But most importantly, their interpretation of article 24 is based on the current generation's responsibility of disposing the waste, so that the future generations do not have to.

The citizen groups, however, are determined. They believe that by burying the waste based on Denmark's (and the world's) current knowledge and expertise, we risk creating a situation similar to Germany's, which will leave future generations far worse off. Trying to salvage the situation of a leaking or otherwise faulty repository is a much bigger burden than supervising and operating an above ground facility.

In the words of Mol, the two central actors move the options of nuclear waste solutions to a different site. A site of an ethical nature: which solution burdens future generations the most? Which is then based on their convictions of whether or not an accident will happen.



4 The sites of the government's choices

However, the fact that the government is bound by article 21 forces them to acquire an ethical stance (we're not stating that this is the only causal link to why the government has made this choice, but it's certainly among the strongest links. The government has faith in the Danish experts' ability to carry out the plan), where they have to believe that they are able to create a facility beneath the ground that will last. If it was not for article 21, perhaps they would be more inclined towards the citizen group's ethical stance: That even though accidents may never happen, it is still just too great a risk. Not just for them, but for future generations as well, who had no say in the matter of which solution to choose.

This raises the question: if a *Member State* is able to properly *demonstrate* that an underground repository puts *undue burden on future generations*, will that undo article 21's notion of disposal of low to medium level active waste limitation to underground repositories? Because that would open up the possibility of investigating a permanent above ground repository solution. And by the way, what happened to the Bunker solution, that we presented in the beginning? It was never mentioned again after the 2002 report made by DD.

If we return to Callon, we can now define the two most important actors' most essential obstacle problems, and by doing so, we insert ourselves into the translation and assume a central actor role. Which makes this report our interessement device to enrol the government and the citizen groups.

The government's most essential obstacle problem is article 21, which forces them to only consider underground solutions (which will always be protested by the citizen groups due to their obstacle problem), and the citizen groups' most essential obstacle problem is the fear of accidents, which makes them adamantly against underground solutions.

Both of these problems can be solved, if article 24 is able to cancel out article 21, which frees up the government to research the bunker solution they once considered. The obligatory passage point is then: Can article 24 cancel out article 21? As illustrated by figure 4.



⁵ OBLIGATORY PASSAGE POINT FIGURE

The bunker is above ground. It can be placed near Risø, where they are already used to living in proximity of radioactive material, which solves the problem of transportation and falling real estate prices. Høfte 42 will cease being an interference, since it is no longer comparable to the proposed solution.

We realize that there may be other sites that we have not discovered, that may explain the government's choice of solution. But we believe that, even if the government is hesitant, the citizen groups, the concerned citizen and the NGOs will be able to convince them, if they are able to rally to this cause.

Discussion

Disposal quality of underground repository solution

A thing that still baffle us, is that there seemed to be an unspoken quality in the fact that the waste is disposed *underground*. Consider the dictionary's definition²¹ of disposal, which is *the destruction or transformation of garbage*, and *the act of getting rid of trash*"²². By burying the waste, it has neither been destroyed or transformed (Well, it will transform, but it will take 3-500 years and it will still be dangerously toxic). We also think that we have proven that it has not been "gotten rid of", because of the risk of failure and the non-physical effects it has on the local community (such as the local real estate market and agriculture).

If there was a strong argument for why it would be *more* disposed of underneath the ground than above, then we have failed to see the connection. But then again, if there really is no argument *for* an underground solution, then that fact in itself, is a strong argument in favour of an above ground solution.

Perhaps it has something to do with security, which we have left relatively unprocessed (because we were insecure about it). As mentioned in the beginning of the analysis; above ground, surface-near and retrievable solutions are less secure against sabotage, unauthorized access and terrorism. But since article 21 *recommends*²³ that low to medium level waste is disposed of in a surface-near facility, (which if Parliament had any say in it would be reversible), then we did not see much reason to differentiate the solutions proposed based on security. Mainly because we are not able to assess how much more secure a surface-near reversible repository is compared to an above ground reversible repository.

If, on the other hand, the government decide to focus entirely on a deep geological disposal solution, then security would definitively be a relevant factor. Which may also be the answer to relieve us of the confusion regarding the unspoken disposal quality of underground repository solutions.

²¹ We hope it's okay, since this is not a wedding.

²² https://www.merriam-webster.com/dictionary/disposal

²³ Well, states, that the typical solution for low to medium level waste is a surface-near disposal

Being able to see the waste

The comfort that the citizen groups felt by being able to enter the facility and actually see the waste safely stored, may be an important factor to the citizens. We are not quite able to determine whether or not this a non-negotiable criterion. But perhaps it will be enough to know that the waste is above ground.

Mobilization issues v. 2.0

Our translation is based on the same mobilization as Kristoffer's, which we described in the previous chapter. This means that new problems could arise if a siting process is initiated outside of the Risø area. It should also be mentioned that we have not included the citizens of Risø in our research, since they were not part of the citizen groups nor were Risø selected as a potential site by GEUS. Most of our contacts in this field are under the impression that the communities local to Risø are so accustomed to nuclear activities, that they would not object to a storage facility. But obviously, that could change if the plans were to place it there for eternity (or until a better solution is found for the long-lived waste).

The NGO's

Greenpeace would undoubtedly be ecstatic if this was the solution that solved Denmark's nuclear waste problem. It's basically the solution they have been rooting for, for almost 20 years. DN would be happy just to see the issue resolved, but then there's NOAH. We are not quite sure how they would react. They have previously been advocating the intermediate storage solution, and it was not until Gerhard Schmidt entered the playing field that they changed their minds. Exactly how committed NOAH is to the deep geological solution is yet to be seen. But we think it is fair to assume that they will be satisfied if the government and the citizen groups (and the concerned citizen) can find some common ground, and agree on a solution.

A successful stakeholder involvement process?

The observation that the Ministry of health mismanaged the stakeholder involvement process may not be the right observation. If you consider the stakeholder involvement processes of other countries, then the Danish situation looks almost healthy. But we must give credit where credit is due; it's mostly thanks to the efforts of UFM and Kristoffer that the process is now improving. However, had it been UFM commandeering the process from the beginning, the situation may have been similar to the Swedish, where they are having issues involving the local communities (even after announcing potential locations for their final repository). If UFM is able to remedy the public's distrust in the government and their experts, they would have the perfect conditions for a successful stakeholder involvement process. Perhaps the havoc wreaked by the Ministry of health has actually provided the means (by severely pissing off the local communities) for every conceivable solution being investigated.

Conclusion

With our analysis of the problematizations by the two central actors, and the subsequent analysis of the options relevant to these problematizations, we have found our way to the core of the issue. The citizen groups' (which is only part of the public, in case you skipped ahead and read the conclusion first) and the government's proposed solution are locked in place due to their respective webs of relations. But if Denmark can demonstrate that an underground repository will put undue burden on future generations, then it may be enough to convince the EURATOM commission to forego article 21. This would allow the government to investigate aboveground final repositories, which will create a common ground with the public.

We realize that our plan may be shaky. That it is based on an uncomfortable amount of ifs and mays. But perhaps it is enough for them to see, that it is not impossible to find some common ground. That there are solutions, which they can both agree on.

Perhaps our description of the central actors will enable someone else to see different solutions, that we haven't seen.

We started out with an idea to use only Mol as our theoretical framework. We had no idea where to begin, there was no structure. Our field was too messy to make any sense of it. We found that the combination of Callon's concept of translation and Mol's concepts of options, sites and interferences to work wonderfully in tandem. Translation provided the structure that we needed to apply Mol's concepts. It was much more simple to apply them after a thorough analysis based on translation. By describing the translations of the two central actors, we had already identified all the relevant sites, options and interference. The only thing that remained were to do some experiments using the concepts.

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Disposing of Denmark's Nuclear Waste

Annex