BEACON
Bentonite Mechanical Evolution

WORK PACKAGE 6
DELIVERABLE D6.1 (revised)

Scoping of the Beacon project, initial civil society (CS) perspectives and enhanced work plan for years 2-4

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Abstract

This is the first report from Work Package 6 (WP6) on civil society (CS) dissemination in the Beacon project. The report includes a description of the background to the inclusion of the work package in the project and a description of the first year's work. The report presents the methodology to be used in the work package for the support of the projects dissemination to the civil society. It includes some initial CS perspectives on the project both in a larger context and on the project's work during the first year for use in dissemination to civil society. Finally, there is a description of how the work in the work package is to be continued for the duration of the project.

Table of Contents

1 Introduction

The inclusion of a specific work package, WP6 on Civil Society (CS) Interaction in the Beacon project was intended as a pilot first-of-a-kind action to test the feasibility and benefits of such activities in a technical EU R&D project. The work package was included as a result of discussions within the EU project JOPRAD between the implementors/waste management organisations (WMOs) of radioactive waste management projects in the Implementing Geologic Disposal Technology Programme (IGD-TP) and the nuclear regulators and their technical support organisations (TSOs) cooperating in the SITEX II project.

The CS expert group in Work Package 6 (WP6) on CS interaction worked for one and a half years in the project including participation in the first annual meeting of the Beacon project on Milos in Greece on May 29-31, 2018.

This report can be seen as a preparatory report from Work Package 6 (WP6) on "Dissemination to Civil Society" for the remainder of the project.

In the first perspective the report includes a background to the original work package as well as a short description of the work done by the CS expert working group during the first year, including the participation in project meetings and workshop.

In the second perspective the revised report includes a scoping of the project from a civil society perspective with initial observations from the WP6 CS expert working group related to the dissemination to civil society. The report also describes how the work within WP6 will proceed for the remainder of the project.

2 Background and methodology

This chapter includes a background to the creation of a work package on civil society (CS) interaction in the Beacon project (WP6) and a presentation of the CS experts working in the work package. The final section describes the change of WP6 into a work package on civil society interaction and the methodology for that work.

2.1 The background for inclusion of a work package (WP) on civil society interaction in the Beacon project

Within Europe the development of transparency in decision-making on issues and projects that affect the environment has a long history. As programmes and projects for radioactive waste management (RWM) can entail significant environmental risks, transparency in RWM is part of this development. RWM projects have been under development, in terms of siting and implementation, in some EU member states since the 1970s. There has been a constant learning process on how to inform and communicate about RWM issues as well as how to involve civil society in the decision-making process. There are some successes but many more failures in siting and implementing RWM projects. Often the reason for failure has been understood to be poor transparency as defined as inadequate public information and insufficient or inadequate public participation. Much work has been done in the RWM sector to try and see how RWM transparency could be improved.

Since the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters[1] entered into force in 2001 the development and understating of how to implement effective environmental transparency governance has increased. All Member States in the European Union as well as the European Union itself are parties to the convention and the convention has to a large extent been implemented in European legislation as well as in the national legislation of the member states. The principles of the Aarhus Convention regarding transparency apply to environmental issues including nuclear energy and are therefore important for transparency in RWM in the European Union.

On July 19, 2011 the Council Directive 2011/70/Euratom was adopted establishing a "Community framework for the responsible and safe management of spent nuclear fuel and radioactive waste", commonly called the Radioactive Waste Directive. There is a clearly stated requirement in the directive for more transparency at the EU level. Recital 31 in the preamble of the directive acknowledges the importance of transparency. It underlines that "transparency should be provided by ensuring effective public information and opportunities for all stakeholders, including local authorities and the public, to participate in the decision-making processes in accordance with national and international obligations".

[1] https://www.unece.org/env/pp/introduction.html.

According to Article 10 of the Radioactive Waste Directive, Member States have to ensure that necessary information on the management of spent fuel and radioactive waste is made available to civil society in the relevant decision-making processes in accordance with national and international legislation. Also, civil society has to be given the necessary opportunities to participate effectively in the decision-making process regarding spent fuel and radioactive waste management in accordance with national legislation and international obligations.

Member States have discretion on how to implement the Radioactive Waste Directive in their national legislation but need to do so taking into account the implementation that has been made of international legislation such as the Aarhus and Espoo[2] Conventions. The development of transparency in RWM in Europe is a dynamic, evolving process, varying from country to country and influenced by each country's cultural background and legal framework. Some countries have already developed rather advanced mechanisms for transparency whilst others are still at an earlier stage.

In order for the civil society to be able to take in and understand information regarding RWM programmes and projects, and in order to be able to participate actively and constructively in consultation processes, the civil society must have access to technical expertise. There are a number of civil society experts, either within non-governmental organisations or for example academics and consultants that interact with such organisations. Still, more expertise needs to be developed, and in a way to provide robust and sustainable conditions for continuity[3].

The existence and importance of civil society expertise was acknowledged in the EU project SITEX that was carried out in 2012 and 2013[4]. The project was primarily an effort by the European radiation safety regulators and their technical support organisations (TSOs) to explore how to build up a network of general expertise to support their work on evaluation the European implementors' RWM projects and programmes. However, the project also contained an effort to understand the role of more general technical expertise in society in order to allow for effective and constructive consultation processes and other interaction with civil society. The project was followed up by the SITEX-II EU project between 2015-2017 that include a special work package on civil society interaction[5]. In the project a number of civil society organisations participated as partners and carried out tasks related to civil society input the development of SITEX-II strategic research agenda (SRA), work on issues regarding safety culture, as well as work on intergenerational governance.

In parallel to the SITEX-II project a EU project called JOPRAD[6] was carried out where the task was to prepare for a so-called joint programming for EU research in RWM. In the JOPRAD project representatives (regulators and TSOs) from the SITEX-II project worked together with

[2] https://www.unece.org/env/eia/eia.html.
[3] Transparency in Radioactive Waste Management (The BEPPER report), Swahn et al., Nuclear Transparency Watch, December 2015 (http://www.nuclear-transparency-watch.eu/a-la-une/new-publication-bepper-report.html).
[4] http://sitexproject.eu and http://sitexproject.eu/index_1.html.
[5] http://sitexproject.eu and http://sitexproject.eu/index_2.html.
[6] http://www.joprad.eu.

representatives from the implementers/waste management organisations (WMOs) that were organised in the Implementing Geologic Disposal Technology Programme (IGD-TP[7]). In the spring of 2016, there were discussions between the IGD-TP and the SITEX-II project regarding preparations for applications for projects for the EU Commission call for new Euratom Horizon 2020 projects. Some options for cooperation were considered, and it was finally decided to include a work package on civil society interaction in the Beacon project. MKG, the Swedish NGO Office for Nuclear Waste Review was a partner in the SITEX-II project and was chosen to take the lead of WP6 on dissemination to civil society. A work programme was written, but it was understood that as this was a pilot first-of-kind venture and that the work programme was written to allow some flexibility during the carrying out of the project.

2.2 The civil society experts

The work package is built around a working group with 4 representatives of different environmental NGOs as civil society (CS) experts. The CS experts were carefully chosen to make up the CS expert working group. The CS experts have a high technical, scientific and generalist competence as described below. To allow an even better contribution from WP6 the CS experts have chosen a technical expert to advise them on the specific subject of the Beacon project.

The CS experts in WP6 together with the technical expert are exceptionally well suited to analyse, discuss, interpret and develop perspectives on the more concrete work with R&D in the Beacon project and to provide the technical writing expertise for dissemination of the results to a broader civil society.

The WP6 work package leader is Johan Swahn, Ph.D., who is the director of the Swedish environmental NGO MKG, the Swedish NGO Office for Radioactive Waste Review[8]. Dr. Swahn has a M.Sc. in engineering physics and also a basic training in radiation physics. He has a doctorate degree in science, technology and global security.

The other members of the WP6 CS expert working group are:

- Nadja Železnik, Ph.D., from Slovenia represents the European environmental NGO called Nuclear Transparency Watch (NTW[9]) that she is also president of. Dr. Železnik has M.Sc. in engineering physics/applied physics and reactor physics and a doctorate degree in psychology on cognitive environmental science. Dr. Železnik has experience working for the Slovenian radiation safety regulator and the RWM implementor and is presently working as a senior expert for the Slovenian TSO EIMV[10].
- József Kóbor represents the Hungarian environmental NGO Green Circle of Pécs. He works as a radiation physics specialist.

[7] https://igdtp.eu.
[8] http://www.mkg.se.
[9] http://www.nuclear-transparency-watch.eu.
[10] https://www.eimv.si/eng/.

– Yves Marignac is director of the French environmental NGO WISE Paris. He has a long experience of engaging in French RWM issues.

While the CS experts are not scientist in the field of clay modelling or experimentation, they do have an ability to comprehend the scientific work done in Beacon.

In addition, the CS expert working group has chosen prof. em. Roland Pusch as their technical specialist to be included in the group to advise them on clay issues. Professor Pusch is an eminent and well-known expert on bentonite clays having worked academically and as a consultant on clay issues his whole life.

2.3 Progress in developing a relevant CS interaction and dissemination framework approach

Experience of civil society engagement in EU Research projects was gained in the SITEX-II project and discussions were held of how civil society interaction could constructively and usefully be carried out in an EU R&D technical and scientific project. Such discussions continued during the development of the Beacon project application for EU Euratom Horizon 2020 funding.

The objectives, description of work and list of deliverables have been developed to allow the work carried out during the first reporting period in WP6 to be used in a conventional dissemination effort. The scoping period work carried out as task 1 of the work package is used to describe the projects background, work and objectives both in larger context and in a description of the planned work during the project and work done during the first year. Both are done in a way that will be useful for dissemination to the civil society. This is done in chapter 4.

It was already decided during the autumn of 2018 that the focus of attention of the WP6 CS expert working group during the remainder of the project was to be on the WP5 tasks and deliverables. This is in also line with the description of work.

In task 2 of the work package the CS expert working group will continuously take part of the project and its results and translate this in a form that can be available to the public[11]. A special focus will be given to the WP5 tasks and deliverables. The CS expert working group will be represented at the annual meetings where a short presentation of the past year work will be made.

[11] When discussing making information available to the public as a dissemination effort, it is important to see that there are different target groups that can be reached. For the purpose of an EU technical R&D project the most important target group is the interested public either involved in or reading about radioactive waste management (RWM) issues. Two particularly important target groups are national and local environmental NGOs and involved persons in local communities that have or are planned for RWM facilities.

In task 3 of the work package, towards the end of the project, the CS expert working group will focus on summarising the work done in the Beacon project. There will be a focus on making the final workshop/conference of the project known, available and understandable to a broader, wider and more numerous group of participants from the civil society than would otherwise have attended. The CS expert working group will also be a contribution to the WP7 efforts to prepare and publish a public summary of the project and to the final project report.

An enhanced work plan for CS dissemination efforts for years 2-4 is presented in chapter 5.

3 Work carried out in WP6 during the first year

This section includes a description of concrete work done by the CS experts in WP6 on CS interaction during the first year including the participation in project meetings and workshops as well as WP6 meetings.

The WP6 leader and two members of the CS expert working group including the scientific expert attended the Beacon project kick-off meeting and workshop in Kaunas on June 19-20, 2017. At the meeting information was gathered to allow work on dissemination of the planned work in the different work packages of the project.

At the first WP6 working meeting in Göteborg, Sweden, on November 22-23, 2017 the CS expert working group had a productive meeting with the support of the group's scientific expert Roland Pusch. The meeting allowed discussion of information to allow work on the dissemination of the project in a larger context.

During the autumn of 2017 the WP6 leader and working group's technical expert made an input into WP2's work to collect previous clay and modelling work. The submitted comment is added as Appendix 1.

The WP6 leader attended the WP3/WP5 meeting on January 16-17, 2017 in Barcelona and the WP4 on February 14-15, 2017 in Berlin[12].

During the late spring the WP6 working group worked on preparing the first version of this report and preparing for the Beacon project annual meeting on Milos, Greece on May 29-31, 2018[13].

[12] The WP6 leader also attended the WP3/WP5 meeting in Paris, January 29-30 January 2019.

[13] The WP6 CS expert working group also met in Malmö, Sweden, on 27-28 September 2018 to work on WP5 issues as it had been decided that this work package was most important to focus on for the dissemination effort for the remainder of the project.

4 The CS expert's scoping of the Beacon project in preparation for dissemination

This section describes the results of the scoping period work carried out to describe the projects background, work and objectives both in larger context and in a description of the planned work during the project. Both are done in a way that will be useful for dissemination to the civil society.

4.1 The project in a larger context

In many countries, also in the European Union, there has been a production of radioactive waste that needs to be safely and securely managed in the short term, as well as in the long-term.

The most long-lived and highly radioactive waste comes from electricity production in nuclear reactors. This waste has to be isolated from humankind and nature for hundreds of thousands of years.

More short-lived and less radioactive waste comes from the operation and decommissioning of nuclear reactors and other nuclear activities, and to a lesser extent from medical and industrial sources.

For the disposition of the radioactive waste in the long term the most commonly proposed way forward is disposal in geologic repositories. There are a few operational final repositories, mostly for the least long-lived and less dangerous radioactive waste. The challenge is to find environmentally safe solutions of how to best move ahead regarding the long-lived and more dangerous wastes.

In different planned projects for final disposal of radioactive waste, clays of different kinds are to be used. Clay is a material that can be difficult for water to move through and this is the main characteristic that makes it attractive as a barrier material.

By using clays as a barrier to surround canisters containing radioactive waste in a final repository it is possible to delay surrounding water from reaching them. This means that the canisters will be less affected by corrosion and the risk of leakage of radioactive particles. The clay will also delay the spread of radioactive particles if the canisters start to leak.

Using a clay barrier around waste containers, often called a clay buffer, can also protect the canister physically if there are forces that affect the radioactive waste repository. Such forces can be due to earthquakes or movement of the surrounding bedrock due to effects of a possible future ice age.

Clay materials as a barrier are also considered for use to seal the tunnels and shafts that have been used while constructing the radioactive waste repository and for transporting the waste down.

Some clays swell if they are exposed to water. Bentonite clays are of this type. As the clay swells it fills up the space around it. And as it swells more and more against the surroundings and against the waste containers the clay can become even more difficult for water to pass through. This characteristic of swelling clays, such as bentonite, make them especially attractive for use as barriers in repositories for radioactive waste.

It is important to be able to know how the clay in a repository will swell after the containers of radioactive waste have been placed in the repository. If the clays do not swell properly or if they swell unevenly it is possible that the long-term safety will not be as high as planned.

It is therefore important to be able to predict how bentonite clays swell when they are used in a repository. Many experiments have been made throughout the years, both at smaller scales in ordinary laboratories and at larger scales in underground laboratories that have repository conditions. The results of the experiments have been used to create models with the ambition be able to predict how the clay will swell.

There is now a relatively good understanding of how bentonites swell. Still, more work needs to be done to understand the details, for example how clay can swell evenly. That clay swells in an even fashion, or as it also called with homogeneity, is important to avoid the uneven build-up of pressure around a canister of radioactive waste. Such uneven pressure can damage the canister. If clay swells unevenly it can also increase the risk that the clay is eroded by flowing water, for example in a tunnel in a repository for radioactive waste.

It is the latter, the problem of uneven swelling of bentonite clay in tunnels, plugs and seals, that is the focus of the Beacon project. Examples of this problem has been shown in the so-called "EB test" in the Mont Terri underground rock laboratory in Switzerland and in the tunnels of the "Prototype Repository" in the Äspö underground rock laboratory in Sweden.

The Beacon project thus has as an overall objective to develop tools in the form of models to understand how swelling bentonite clays behave in a repository environment. The waste management organisations that have the responsibility for management and disposition of radioactive waste need such tools to be able to show that the repositories can be safe. The radiation safety regulators will expect that the tools are sufficiently good to predict how the bentonite clays in a repository will swell to give long-term safety.

4.2 A presentation of the planned work to be done in the project and the work done in year 1

The Beacon project is a research project financed by the European Commission. The project started in June 2017 and will continue for four years. Towards the end of the project there will be a conference in London in April 2021. At the conference a special effort will be made to make it possible for representatives of civil society (environmental NGOs and local communities with radioactive waste management project) to take part and learn more about the project and its results.

In the Beacon project the focus is on trying to understand how bentonite clay swells in actual proposed systems for radioactive waste disposal. Three different case have been selected that are representative of the main uncertainties in how bentonite clay may swell unevenly:

1) a so-called "tunnel plug" in the design for a repository concept that the French radioactive waste management organization Andra has developed (see figure 1);

2) a so-called "disposal cell" from the repository concept that the Swiss radioactive waste management organization Nagra has developed (see figure 2); and,

3) the so-called "backfill" of deposition tunnels in the "KBS-3 method" deposition tunnel backfill that the Swedish radioactive waste management organization SKB has developed (see figure 3).

These cases are cover a broad range of issues and the project expect that the results should be applicable to other concepts and systems as well.

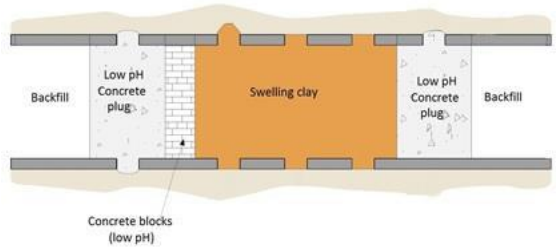

Figure 1 Tunnel plug in the ANDRA concept

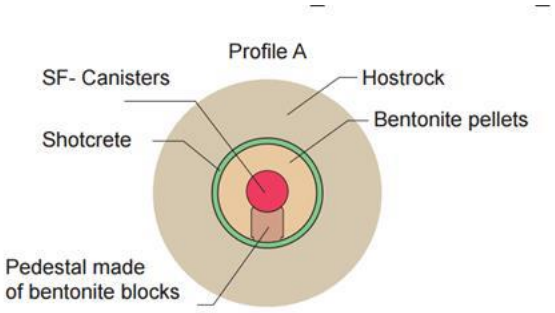

Figure 2 Disposal cell in the Nagra concept

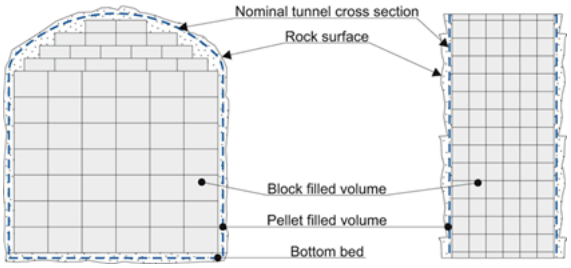

Figure 3 KBS-3 Tunnel backfill

The Beacon project has five work packages that fulfil different functions in the project[14].

In the first work package (WP1) a number of the European radioactive waste management organizations[15] in the beginning of the project gave their input to the project with descriptions of how they expected to use clay in different projects. They also provided their expectations on the project. This is reported in a report called deliverable D1.1 "Beacon - Bentonite Mechanical Evolution: State-of-the-Art Report".

The second work package (WP2) has collected information about previous experiments and modelling done on clay that have been performed within European projects as well as within the national radioactive waste management programmes. The result is a report called deliverable D2.2 "Review of data and models on the mechanical properties of bentonite available at the start of Beacon".

In the third work package (WP3) modelling development work is done. There are approximately 13 modelling teams working in the work package.

The fourth work package (WP4) is an experimental programme to support the development and testing of models. There are approximately 8 experimental teams working in the work package.

The fifth, and perhaps most fundamental, work package of the project (WP5) coordinates the testing of models with experimental data, i.e. the work of WP3 and WP 4. Before data is available within the project itself several test cases with data from previous experiments are to be used by the modellers of WP3. This is task 5.1 and test case data from three previous experiments have been chosen:

1. "Swelling pressure tests for compacted plugs with free volume available" from an experiment carried out by the company Clay Technology AB for the Swedish radioactive waste management organisation SKB;

[14] In total there are 8 work packages in the Beacon project including the WP7 on dissemination and WP 8 on project management. How the different work packages interconnect is described in the figure in appendix 2.
[15] Nagra (Switzerland, SÚRAO (Czech Republic), Posiva (Finland), Enresa (Spain), GRS (Germany) and SKB (Sweden).

2. “Swelling pressure tests for pellets mixture” from the French research organisation CEA for the French radioactive waste management organisation Andra; and

3. “Swelling pressure tests for block and pellets structure” from Finnish radioactive waste management organisation Posiva.

For the first year the modellers have focussed on modelling the first test case and the results were presented at the first project annual meeting. This is to be covered in deliverable D6.2 from WP6.

5 Enhanced work plan for CS dissemination efforts for years 2-4

This chapter describes the developed enhanced work plan for tasks 2 and 3 of the WP6 on civil society dissemination for the years 2-4 of the project.

In task 2 the WP6 CS expert working group will during the remainder of the project continuously take part of the project and its results, and translate the results to the public. Since WP5 is the core component of the Beacon project, and its tasks in a way are the essence of the project, the WP6 group will give special focus to the WP5 tasks and deliverables, and deliver an elucidation of the work and results targeted at civil society.

During year 2 there will be a focus on the WP5 work on verification and validation of models, and comparing models with situations close to disposal conditions (task 5.1 and 5.2 of WP5). A deliverable with CS perspectives on this work will be prepared as a draft for the second annual meeting of the project and finalised in month 24 of the project.

During year 3, and as necessary during year 4, there will be a focus on the WP5 work on predictive simulations and models applied to assessment cases (task 5.3 and 5.4 of WP5). A deliverable with CS perspectives on this work will be prepared as a draft for the third annual meeting of the project and finalised in month 35 of the project.

As necessary, the work done in WPs 1-4 will also be followed. The work done on WP3 on modelling and WP4 on experimentation naturally connect to the work done in WP5.

Towards the end of the project, the CS expert working group will summarise their part of Beacon in task 3 of the work package. There are two sub-tasks.

Subtask 3.1 is focussed on making the Beacon final workshop/conference in London in 2021 known, available and understandable to a broader, wider and more numerous group of participants from the civil society. There might be a preparatory session as a first session of the workshop, open to both the public and Beacon partners, and aimed at giving broader access to the results of the work in the project, facilitate translation of the Beacon project and create conditions for civil society local and national representatives and a larger network(s) of environmental NGOs to understand the project results.

Subtask 3.2 is focused on providing contributions from the WP6 Cs expert working group to the work of WP7 in the preparation and publication of a public summary of the project and the final project report.

Appendix 1: Input to WP2 (Collection/completion and compilation of existing data and available models)

In this appendix WP6 gives an input into the work of WP2 (Collection/completion and compilation of existing data and available models). WP6 has studied the November 24 draft report of deliverable D2.2 "Review of data and models on the mechanical properties of bentonite available at the start of Beacon" and has the following comments:[1]

1. It is an impressive list of bentonite experimental work that is described in the draft report. The challenge going forward is to be able to get the most relevant information out of the effort and provide optimised input the other Beacon work packages.

2. The list of identified and described projects includes a few projects that are classified as "not suitable for mechanical modelling in Beacon".

   In the working group of WP6 we have discussed, amongst other issues:
   a) the importance of the interface to waste canisters and the interface to the host rock for understanding and modelling the behaviour of the bentonite clay;
   b) the importance of the total modelling of THMCBR in order to fully understand clay behaviour;
   c) the importance of the chemical evolution of the clay due to temperature or due to interaction with the waste canisters;
   d) the understanding that as the efficiency of disposal could be improved with more compaction of canisters which would in turn lead to higher temperatures in the clay, the understanding of how clay behaves and can be modelled at higher temperatures could be of relevance.

   The WP6 working group understands that there are limitations to what type of modelling the Beacon project is attempting. However, the project would appear to also be a step into further work on clay issues in the forthcoming European Joint Programming (EJP) in RWM and possibly more ambitious modelling work in the future. Therefore any collection of input into the project should be ambitious in order to also be useful in future broader modelling work.

   This means that:
   a) it is possible that the BRIE (Bentonite Rock Interface Experiment) experiment that examines the hydrology of the bentonite/rock interface will be important in future modelling work.
   b) it is possible that the TBT (Temperature Buffer Test), despite high temperatures adding complication, will be important in future modelling work

[1] These comments were also sent to WP 2 on by e-mail on November 29, 2017.

Additionally, in the list of identified projects that do not have more detailed information included in the draft report is the ABM (Alternative Buffer Materials) project. It is classified as ”not suitable for mechanical modelling in Beacon” as it is mainly focussed on mineralogical stability. As chemical changes in the bentonite can affect mechanical characteristics, the project may hold relevant information for the Beacon project. The ABM project is not described in the last two annual reports from the Äspö Hard Rock Laboratory but a description can be found as section 4.3 in the report "SKB TR-15-10 Äspö Hard Rock Laboratory. Annual Report 2014 (http://www.skb.com/publication/2482068/)”. The is a reference to an article by Svensson and Hansen (2013) in the text. As far as can be seen the latest SKB report on the project is ”SKB TR-11-06 SKB TR-11-06 Alternative buffer material. Status of the on-going laboratory investigation of reference materials and test package 1 (http://www.skb.com/publication/2442994/)”. SKB should be able to provide more information on the project and further results.

3. There are a number of other identified projects in the list of projects, some of them major and likely important, that do not have more detailed information included in the draft report. The reason for this may be differing but an effort should be made to make the list as complete as possible. It should be an objective of the project to do this.

   The WP6 working group can provide more information of the following projects:

   a) The modelling of the DECOVALEX I - Test Case 3, Big Ben, is described in the report ”SKB TR 95-29 DECOVALEX I - Test Case 3: Calculation of the Big Ben Experiment Coupled modelling of the thermal, mechanical and hydraulic behaviour of water-unsaturated buffer material in a simulated deposition hole” (http://www.skb.se/publikation/12042/)". SKB should be able to provide more information about the project.

   b) The LOT (Long term test of buffer material) project is last described in the 2011 annual report from the Äspö Hard Rock Laboratory in section 4.3 of the report, "SKB TR-12-03 Äspö Hard Rock Laboratory. Annual Report 2011 (http://www.skb.com/publication/2410794/)”. The reports of the uptake of the experimental packages S1 (standard 90°C, 1 year) and A1 (adverse 130°C, 1 year), A0 (adverse 130°C, 1 year) and A2 (adverse 130°C, % year) are in the reports SKB TR-00-22 (http://www.skb.com/publication/17931/), SKB TR-09-31 (http://www.skb.com/publication/2224202/) and SKB TR-09-29 (http://www.skb.com/publication/1961944/) respectively. Three are two more standard experimental packages and one more adverse to be retrieved. These are now 17 years old. SKB has stated that one standard package (LOT S2) is to be retrieved in the present three-year R&D period, i.e., before the end of 2019 and the last two packages should be retrieved by 2023. There has been some modelling work connected to the LOT project. Of interest for the chemistry of the canister/clay interface may be that at the hottest part of the A2 package copper/clay interface the copper content in the first cm of clay was on the order of 1%. SKB should be able to provide more information about the project.

4. The WP6 working group has in addition identified two other ”projects" involving bentonite that may be of interest to the project:

   a) In one of the CROP (Cluster Repository Project) project reports there is a section 5.6 on ”Modelling”: "SKB IPR-04-55 CROP - Cluster Repository Project. Deliverable D6. Comparison of repository concepts & recommendations for design and construction of future safe repositories (http://www.skb.se/publikation/1053811/). The section is rather broad and describes modelling of the Prototype Repository which is also covered by other SKB report.

   b) The work of Dr. Stephan Kaufhold at Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) regarding bentonite chemistry may be useful for understanding the chemical characteristics involved when modelling the performance of bentonite clays. A list of publications is available at https://www.bgr.bund.de/DE/Themen/GG_Mineral/Mitarbeiterseiten/kaufholdS.html .

Appendix 2: Interconnections between the work packages in Beacon