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# DOPAS

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## DOPAS Periodic report 1 (0-18 M) Publishable summary

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### Dissemination Level

<b>PU</b>	Public	X
<b>PP</b>	Restricted to other programme participants (including the Commission)	
<b>RE</b>	Restricted to a group specified by the partners of the DOPAS project	
<b>CO</b>	Confidential, only for partners of the DOPAS project	

DOPAS



Scope	Publishable summary	Version:	1.0
Type/No.		Total pages	2+6
		Appendixes	
Title	DOPAS Periodic report 1 (0-18 M) Publishable summary	Articles:	3

**ABSTRACT:**

DOPAS periodic report 1 for period 0-18 M starting 1.9.2012 and ending 28<sup>th</sup> of February 2014 was prepared in March-April 2014. The Publishable summary is one part of the first DOPAS Periodic report.

**RESPONSIBLE:**

*Posiva Oy, Johanna Hansen*

**REVIEW/OTHER COMMENTS:**

Consortium did review the text for DOPAS Periodic report 1 (0-18 M) Publishable summary in April 2014.



## 1. Summary description of project context and objectives

The DOPAS Full-Scale Demonstration Of Plugs And Seals (DOPAS) project aims to improve the adequacy, consistency and industrial feasibility of the plugs and seals to be used in disposal facilities for radioactive waste across a range of different geological environments. The data and modelling results from five plug and seal full-scale demonstration experiments, laboratory tests and performance assessment studies will be compiled and reported within the project and the knowledge and experience gained will be shared via several dissemination events.

The DOPAS project team, consisting of fourteen beneficiaries from eight European countries, brings forward important demonstration activities in plugging and sealing, which are required ahead of repository construction in order to build confidence in their implementability and performance. These demonstration activities are also a part of each participant's long-term research, development and demonstration (RD&D) programmes and the need for these experiments, and the use of the data generated, have been identified in these RD&D programmes. Only those parts of the activities that are needed for integration of the results and for sharing of the experiences are undertaken within DOPAS. However, the broader aspects of the work are included within published reports from the project. In some cases, the use of results is connected to licensing applications expected to commence soon, or to development of underpinning evidence that will be used for building public confidence and supporting future license applications.

Demonstration experiments which will be partially or wholly implemented during the DOPAS project are a full-scale seal (FSS) implemented on the surface in Saint-Dizier, France, an experimental pressure sealing plug (EPSP) underground in the Josef Gallery in Czech Republic, a deposition tunnel dome plug (DOMPLU) in the Äspö Hard Rock Laboratory in Sweden, a deposition tunnel wedge plug (POPLU) in the underground rock characterisation facility ONKALO (future spent fuel repository) in Finland, and components of a shaft sealing system (ELSA) in Germany. The DOPAS project is implemented in seven work packages (WPs). Three WPs are research and technological development (RTD) activities, and consist of development of the design basis and conceptual design work for plugs and seals to be demonstrated within DOPAS (in WP2); performance assessment of plugs and seals (in WP5); and integrating analyses of the DOPAS project (in WP6).

Two of the work packages are demonstration (DEM) activities and covers (in WP3) the detailed design of plugs and seals to be tested, laboratory characterisation and development needed for selecting proper materials and technologies for plugs and seals, tests in metric scale and practical construction and installation of demonstrations and their reporting; and (in WP4) the monitoring and follow up of the demonstrations, including the analyses on the plug and seal behaviour. WP3 and WP4 also summarise and synthesise generic learning on plugs and seals achieved in the DOPAS project. Two supporting work packages are WP1 for management and coordination and WP7 for dissemination.



Twenty-three deliverables, out of a project total of seventy-four, have been issued during the first eighteen months of the project, and fifteen of them are publicly available on the DOPAS web site [www.posiva.fi/dopas](http://www.posiva.fi/dopas). Ten more deliverables originally planned to be issued during the first period will be published during the second period owing to slight delays in the experiments. All planned seven dissemination related deliverables have been published and altogether thirty-nine dissemination activities have been performed during the first reporting period giving significant visibility to the DOPAS project.

## 2. Description of work performed and main results

Within DOPAS project the design basis, conceptual design and detailed design of the experiments have been elaborated and discussed within the DOPAS Consortium. This work has been useful to understand different approaches to the experiments based on the specific disposal programme of the participating waste management organisation (WMO). As a result, the design basis and criteria report (D2.1) was published.

Experiment 1, FSS, has progressed with experiment design (D3.2), low pH material formulation and laboratory and field characterization of SCC (combined into the D3.8) and the construction of the FSS test box (drift model) (D3.10). Thereafter, the first containment wall, made of self-compacting low-pH concrete, was successfully cast in summer 2013, and is now being monitored. Emplacement of the swelling clay core has been delayed. The most significant aspect of the delay occurred in the metric scale tests, where the laboratory achieved target could not be reached, requiring review of the target requirements and additional laboratory and field work to be undertaken.



Figure 1. This Experiment 1. FSS drift model has been partly filled with concrete. Photo: Andra.



Experiment 2, EPSP, has achieved most of the milestones as planned: general design and planning (D3.16), material characterization (D3.17), and selection of test location and site preparation. Some tender delays encountered have been compensated by undertaking additional "in house" work, thus the main activities planned for the 2nd 18 month period are expected to be completed to schedule. No additional technical challenges are foreseen.



Figure 2. Experiment 2. EPSP test site characterisation. Photo: CTU.

The Concrete dome of Experiment 3, DOMPLU, was cast on March 13, 2013, and the monitoring phase has been commenced. The DOMPLU sensors are performing well (90% are still operational as 10 out of the 100 sensors have failed owing to the high pressure grout injection) and the monitoring is showing the expected trends. The swelling pressure of the bentonite seal is increasing slowly as expected. The pressurisation of the experiment began during the summer of 2013 and has reached 4 MPa. Pressures in excess of 4 MPa have resulted in the opening of pre-existing fractures in the near-field rock and this result will be considered in further development of the design basis.



Figure 3. Experiment 3. DOMPLU plug 28 after plug casting. Photo:SKB.



Experiment 4, POPLU, has made significant progress on all aspects, including selection of the plug location using the rock suitability classification procedure (D3.26), the detailed design (D3.24), monitoring plans (D3.25), laboratory work for concrete specifications (D3.27), and preparations for construction. Some minor design changes, rock safety considerations, and interactions with the Finnish Nuclear Safety Authority related to excavation permits have caused a slight schedule drift, but with no significant impact on the overall timing.

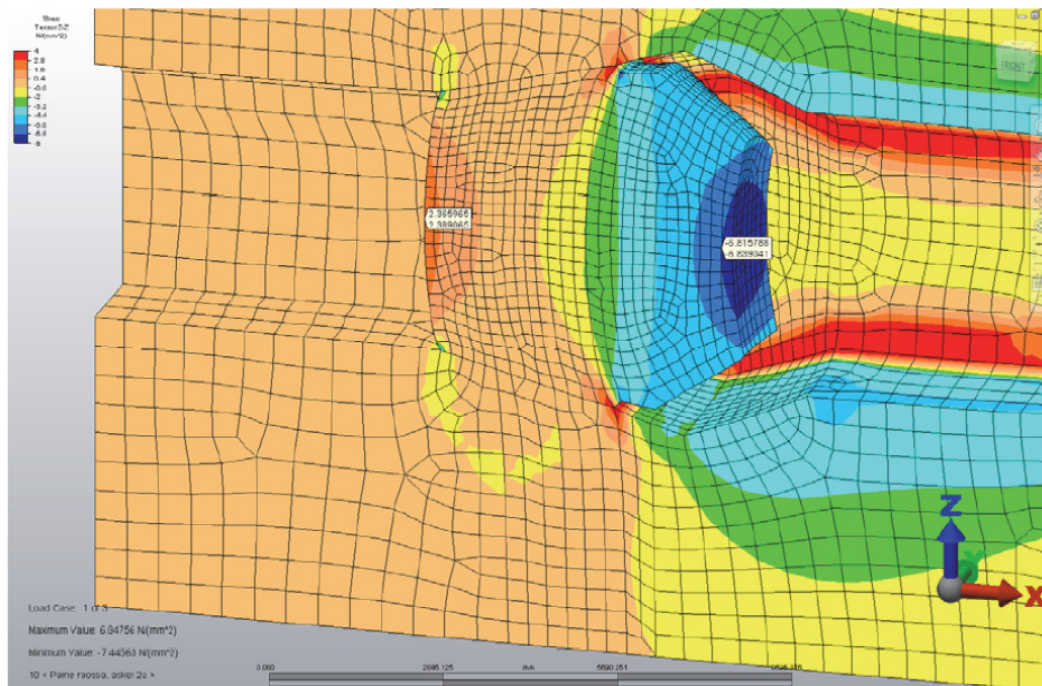


Figure 4. Example of Experiment 4. POPLU FE-modeling, of water pressure around plug associated with 4.5MPa pressurization. Figure: POPLU project.

Experiment 5, ELSA, and other German led WP3 activities (LASA, LAVA and THM-TON) consist mainly of development in the state-of-the-art in shaft sealing design, laboratory studies of material properties to derive data for modelling, and in situ material tests. These activities are ongoing and the first report will be published in the second period of the DOPAS project as planned.

Delays in demonstrating the full-scale implementation of plugs and seals has not resulted in DOPAS targets being missed, but shows the importance of full-scale demonstrations and their role in preparing for implementation. The programme for exchange of experts has been planned and will be implemented during the second period in ONKALO, the Josef Gallery and in Saint Dizier.

The performance assessment work package has been served input for the state-of-the-art in performance assessment and for the regulatory background as well as for preparatory work to define boundary conditions and specifications for the experiments during the first period of DOPAS project. The calculations and numerical simulations have in practice generated the definitions for initial behavior.



### 3. Expected final results and potential impacts

DOPAS is a practical demonstration experimental project with one specific target to increase public confidence by informing a wide audience about the safety of geological disposal, the importance of demonstrating full scale safe plugs and seals, and the state-of-the-art and practical implementation of such demonstration work. Demonstrating plugs and seals at full scale is an essential part of RTD work gain experience on new and innovative methods and how they are applied for construction of repositories. Other WMOs will be able to benefit by obtaining strategies that show how to proceed from the design basis phase into the implementation phase.

The DOPAS results can be used for different geological environments including crystalline host rock, clay host rock and salt host rock. The main results from the DOPAS project in addition to the demonstrators will be the summary reports for the DEM and RTD work packages (WP2-WP5), which will compile the experiences and lessons learned from implementing the full-scale demonstrations, including information on development of design, selection on materials, practicalities related to industrial feasibility, and methods for assessing the experiments and how they fulfil the requirements.

The main public reports will be subjected to independent review, using the so called Expert Elicitation procedure, which will be used for assessing the quality of the reports later in the project. A pilot Expert Elicitation was performed using draft reports on the design of the POPLU monitoring programme (D6.1.1). The pilot identified improvements to the POPLU instrumentation plan (D3.25) and served as a training exercise on the use of the Expert Elicitation procedure within DOPAS.

Among other dissemination activities, DOPAS will organise an international plugs and seals training workshop in Autumn 2015, targeting among others younger scientists within and outside the DOPAS consortium. The training workshop will include practical exercises for increasing the participants' understanding of multidisciplinary thinking in waste management and disposal implementation. The applicants for the training workshop should, therefore, represent a wide range of research and technical areas. An international topical seminar on plugging and sealing technology for geological disposal of radioactive waste will be organised towards the end of DOPAS project (mid-2016), where the results of the project will be presented to WMOs and the wider scientific community. The seminar will be organised collaboratively with the Implementing Geological Disposal Technology Platform (IGD-TP). The experience gained from the demonstrations will contribute towards the construction and operation of repositories by showing the safety and feasibility of constructing plugs and seals using qualified and approved components suitable for repository implementation. Further, they will demonstrate feasibility of installation of plugs and seals at the industrial scale, application of control methods for evaluating results in comparison to the design basis, and verification of design compliance to design basis.



## List of DOPAS Project Partners

1 Posiva	Posiva Oy (Finland).
2 Andra	Agence nationale pour la gestion des déchets radioactifs (France).
3 DBE TEC	DBE TECHNOLOGY GmbH (Germany).
4 GRS	Gesellschaft für Anlagen und Reaktorsicherheit (Germany).
5 Nagra	Die Nationale Genossenschaft für die Lagerung Radioaktiver Abfälle (Switzerland).
6 NDA	Nuclear Decommissioning Authority (United Kingdom).
7 SURAO	The Radioactive Waste Repository Authority (Czech Republic).
8 SKB	Svensk Kärnbränslehantering AB (Sweden).
9 CTU	Czech Technical University (Czech Republic).
10 NRG	Nuclear Research and Consultancy Group (The Netherlands).
11 GSL	Galson Sciences Limited (United Kingdom).
12 BTECH	B+ Tech Oy (Finland).
13 VTT	Teknologian Tutkimuskeskus VTT (Finland)
14 UJV	UJV Řež a.s. (Czech Republic).