



December  
2014

# DOPAS Newsletter 3

## DOPAS facts

### Full-scale Demonstration Of Plugs And Seals

- Project start: 1.9.2012, Length 4 years (48 months), Project end: 31.8.2016
- 14 Partners from 8 European countries (Posiva, Andra, DBE TEC, GRS, Nagra,

RWM, SURAO, SKB, CTU, NRG, GSL, BTECH, VTT, UJV)

- 5 full-scale experiments wholly or partially implemented within DOPAS



**Turku Cultural Year Seal will welcome you all to Turku City for the DOPAS 2016 Plugs and Seals Seminar in early summer 2016!**

More information in this DOPAS Newsletter 3 and on the DOPAS webpage.

Seal at Turku City (FINLAND, approximately 165 km west from Helsinki and 110 km from Olkiluoto.). © Johanna Hansen

The research leading to these results has received funding from the European Union's European Atomic Energy Community's (Euratom) Seventh Framework Programme FP7 (2007-2013) under grant agreement no 323273, the DOPAS project.



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# WP3 & WP4 - Experimental summaries

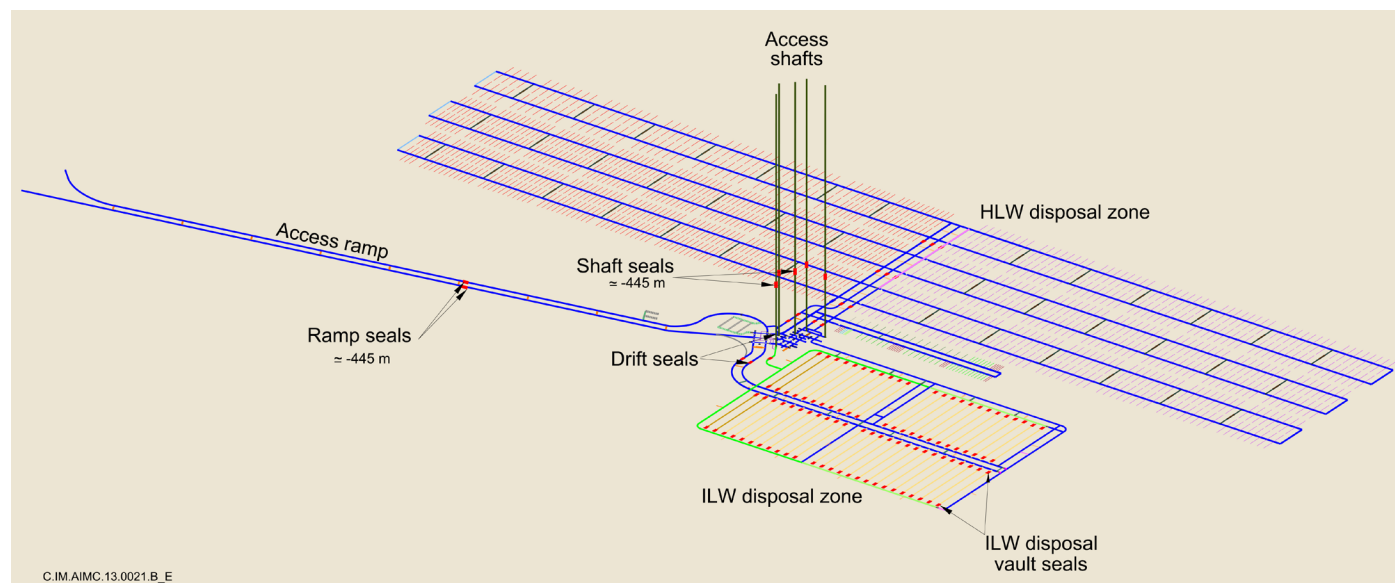
## DOPAS Experiment 1 FSS casted in September 2014

FSS full scale demonstration as example of Cigéo sealing structure has progressed:

- The final phase of major emplacement activities was finished when the low pH shotcrete containment wall was installed in September 2014. Andra is now working on the assessment of the experiment by interpretation of the data already available: concrete containment wall sample coring, analysis of gamma-gamma logging & analysis of Time Domain Reflectometry (TDR) data for the swelling core. The results collected will inform Andra about the fulfilment of requirements as initially set up for the seal. The FSS Experiment will be dismantled later (end 2015) to obtain more information from in situ conditions to support the experimental data collected.
- REM “metric scale resaturation” test, which is part of DOPAS WP5 was installed in September 2014. The aim of the REM test is to increase the phenomenological understanding of swelling clay core (same mixture as that emplaced in FSS) behavior in near natural resaturation conditions. The REM experiment is instrumented; it includes both experimental and numerical hydro mechanical simulations and benchmarking.



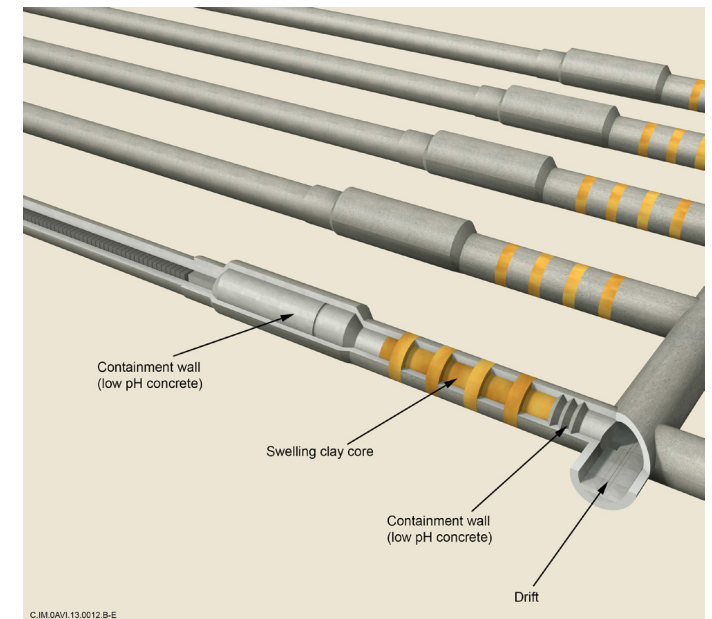
REM Experiment implemented parallel to the FSS Experiment © Andra.



Different type of plugs and seals to be needed in Cigéo © Andra

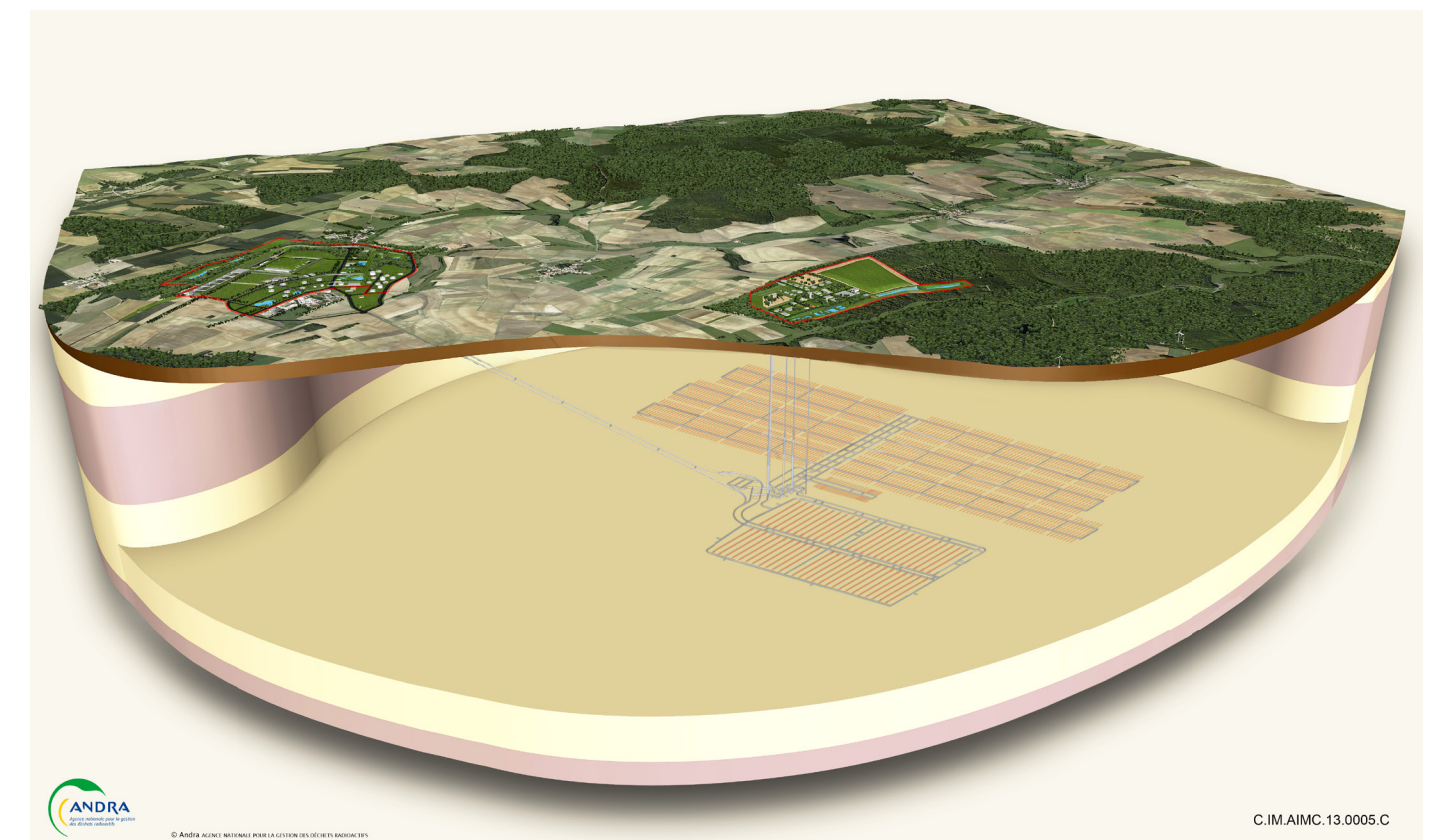
## French general agenda toward a deep geological disposal facility (Cigéo) and role of the plugs and seals

- Andra's Dossier 2009 “(An update of Dossier 2005)” was asserted by the regulators, who pointed out the need to complete some safety and industrial demonstrations regarding the repository closure, especially concerning the seal components: containment walls and swelling clay cores. This was the rationale to implement the FSS Experiment.
- Andra's licensing file for Cigéo (called DAC, scheduled in 2017) will include among other subjects the outcomes of the FSS Experiment to justify the industrial feasibility and performance of the seals.
- At a later stage, an underground full scale horizontal seal demonstrator will be built in situ at the beginning of the construction of Cigéo (during what is called the Pilot Phase, which should last around 10 years).
- The current schedule is to start the Cigéo construction in 2019 and to emplace the first waste package in 2027.



Plug and seal lay-out in clay rock © Andra

<http://www.cigeo.com/en/>



3D diagram of the planned future disposal facility (Cigéo) © Andra





# DOPAS 2016

## Plugging and Sealing Seminar

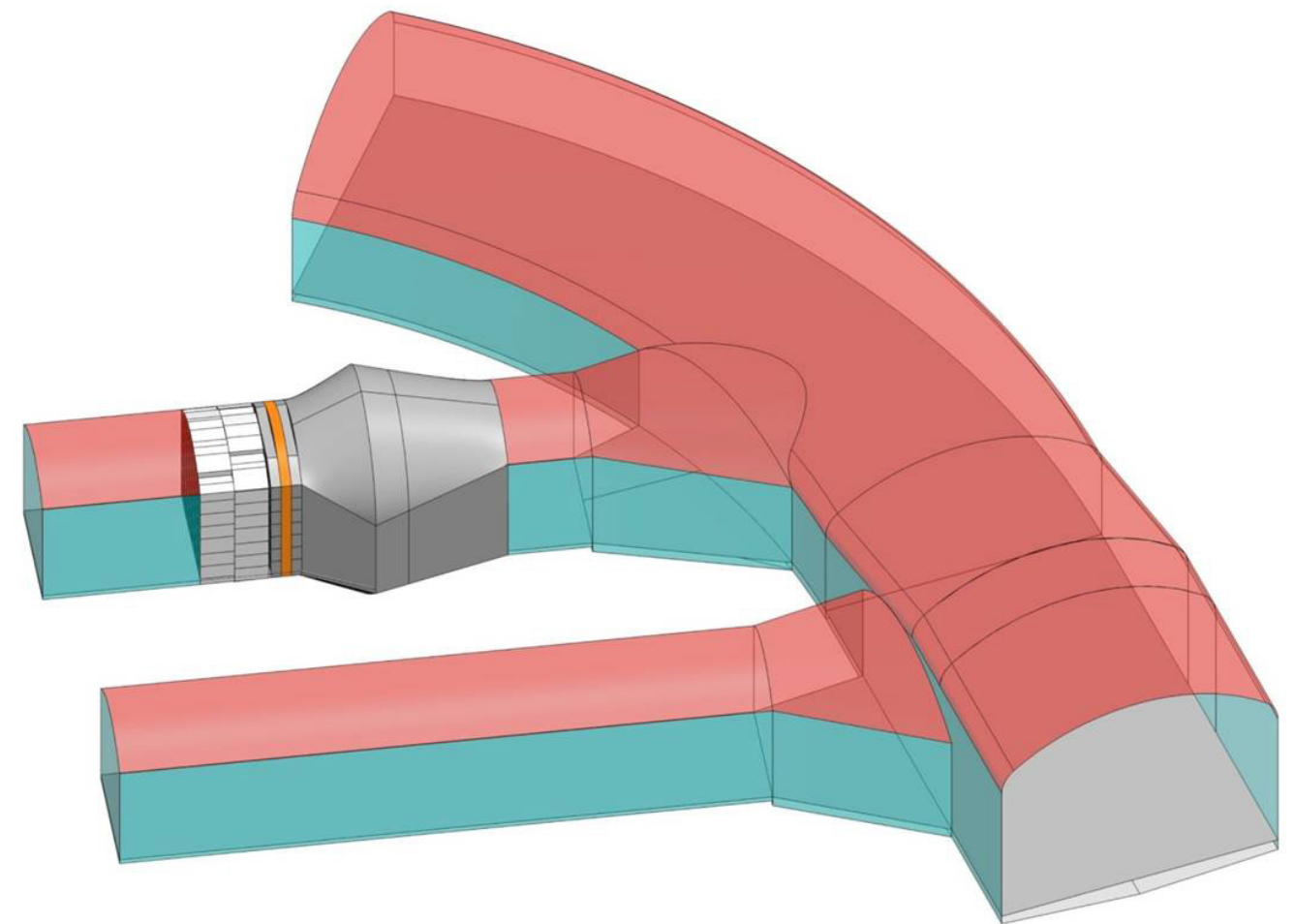
Location Turku Finland

This seminar is open for anyone who is working now or in the future with full -scale experiments related to the radioactive waste management and spent fuel disposal in geological formations.

Plenary, oral presentations and poster sessions will be organized. An optional technical tour to Finland's repository location of Olkiluoto will be arranged.

### Preliminary schedule:

- Call for abstracts Summer 2015.
- Deadline for abstracts 12/2015.
- Final programme available 2/2016.
- Seminar 5/2016 or 6/2016 to be decided soon.
- Stay tuned to DOPAS and IGD-TP web pages for more details.



[www.posiva.fi/en/dopas](http://www.posiva.fi/en/dopas)

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## DOPAS Performance assessment of plugs and seals system

One part of the full scale demonstrations are to understand the behaviour of the experimental set up and also provide information towards the safety case. In different DOPAS experiments the following information is gathered to be judged in WP5 and provide theoretical background for safety assessment work. Main use of WP5 work is to design seal and to support construction; to predict experiment evolution; to predict material behaviour and to test models.

- Safety functions tested
  - Mechanical stability (3x)
  - Hydraulic conductivity / water tightness (7x)
    - Initial
    - Long-term
- The codes in use are process level codes with the exception of two integrated level codes:
  - Codebright is the mostly used code.
  - Commercial codes applied are: Particle Flow Code (PFC), 3DEC, ALGOR, FEFLOW, Goldsim

- Free codes from research are (publicly available): EQ3/6, PhreeqC, Code\_Bright, OpenGeoSys
- Company specific codes are: CLOE, LOPOS
- Inputs used are from
  - Laboratory experiments from WP3
  - Laboratory data outside of DOPAS
  - Literature
  - Actually non experimental input from in-situ experiments has been applied as input.
- Modelled outputs received are:
  - Flow rates
  - Pore pressure, total pressure
  - Stress, load
  - Saturation
  - Porosity
  - Permeability
- Main use of DOPAS performance assessment work
  - To design seal and support construction
  - To predict experiment evolution
  - To predict material behaviour
  - To test models



### DOPAS Experiment 2 EPSP progress

The EPSP plug location has been instrumented and the inner plug has been emplaced by shotcreting technology. The work will continue with clay core emplacement.

Tunnel is ready for emplacement actions. © CTU and SURAO

## DOPAS Staff exchange programme

### Expert Staff Exchange Visits started in June 2014

DOPAS work under the WP6 includes besides opportunities for learning from each other's experiments also opportunities for other consortium personnel besides the project personnel. Already two staff exchange visits were carried out in 2014 and a third one is scheduled for February-March 2015.

The first visit to the FSS experiment in St. Dizier in France was organised in June 2014, where three experts participated to learn from the initiation of swelling clay core emplacement activities and from the related logistic operations. This well organised exchange programme provided sufficient time to observe the filling operations, to discuss, to ask questions and to provide the visiting experts inputs on the activities carried out to hosting staff at the site. The main learning outcomes from the visit were related to understanding of the extent of the laboratory programme backing the actual full-scale experiment; and the handling of the material and the on-site measures to meet the work environment challenges like dust formation from the filling operations. The auger conveyor emplacement method of the FSS experiment for bentonite pellets can be applied for other filling concepts, too. Exchanges between the visiting experts and the hosts covered discussions and feedback related to the facility layout and capacity needs; improvement of the density of clay material; and clay filling procedures. In addition, a visit to the Bure Underground Research Laboratory was made to complement this exchange visit. This visit, too, was valuable and provided an opportunity to see the various experiments being undertaken underground, including those related to the FSS Experiment.

The second staff exchange visit to the Czech EPSP Experiment in the Josef facility took place in the middle of November 2014. The focus of the visit was on the construction of the plug with shotcreting.

The third and final scheduled staff exchange visit is planned to take place in ONKALO, Finland, during late February - early March 2015. The visit will focus on the plug construction of the POPLU Experiment. Call for the site visit will be out early January 2015.

More information on the experiments is available on the DOPAS web page [www.posiva.fi/en/dopas](http://www.posiva.fi/en/dopas).



© Andra





## DOPAS Experiment 4 POPLU slot production

The plug requires an excess in the bedrock and the production of the plug location is one part of the POPLU Experiment. The method needs to provide a smooth surface, without causing extensive EDZ zone in the surrounding rock. POPLU slot production is being produced by coring, wedging and grinding method. This type of shape has not been produced in practice and several companies were interested to participate to the R&D demonstration in ONKALO rock characterisation facility. Posiva had developed and tested the grinding method for other purposes as part of the tunnelling work and the method seems to fulfill the requirements for production of rock surface in area where the plug will be casted.

SKB has tested the wire sawing method in their DOMPLU Experiment for the production of their slot for plug.

Within DOPAS the aim is to compare two different plug experiments constructed in crystalline bedrock; I.e Experiment 3 DOMPLU and Experiment 4 POPLU. Also the slot production methods with wire sawing used for DOMPLU and the coring, wedging and grinding method used for POPLU will be compared.



© Posiva



Production of plug location with grinding is a pioneering process. Johanna Hansen and Sanna Mustonen from Posiva are studying the wearing of the grinding tool. © Marjatta Palmu/DOPAS.