Executive Summary:
DOPAS Project, Full-scale Demonstration of Plugs and Seals, is co-funded by the Euratom FP7 programme and by eight waste management agencies and the German Ministry BMWi. The project has 14 partners from 8 European countries. The Project was carried out during 2012 - 2016.

The DOPAS Project consisted of seven work packages and it was coordinated by Posiva Oy. The Posiva coordinator lead work packages WP1 (Project management and coordination) and WP7 included the coordination and project management and various dissemination activities of the project including a training workshop and an international seminar. WP2, WP3, WP4 and WP5 addressed, respectively, the design basis, construction, compliance testing, and performance assessment modelling of full-scale experiments and materials research projects.

WP2 lead by SKB included the development of the design basis for the experiments and lead to a generic work flow for developing the design basis for sealing from the requirements and the functions of the sealing structures.

In the DOPAS Project, Research, Development and Demonstration work was carried out on five full-scale sealing experiments belonging to the WP3 that was lead by Andra: WP4 that was lead by RWM assessed the compliance of the experiment designs and experiments to their developed design basis and collected the major lessons learnt from the experiments. Extensive monitoring and material development programmes were implemented as a part each experiment in cooperation with the other project partners.

The DOPAS Project focused on drift, vault, tunnel and shaft plugs and seals for clay, crystalline and salt rock environments. Following experiments were carried out: FSS seal by Andra and Nagra in France, EPSP plug by SURAO (former RAWRA) and CTU in the Czech Republic, DOMPLU and POPLU deposition tunnel plugs in cooperation between SKB (Sweden) and Posiva (Finland) in their respective countries and ELSA project related experiment work in Germany by GRS and DBETEC.

WP5 lead by GRS carried out and collected the experiences of the different types of modelling used to predict and access the processes that the experiments were influenced with and at the performance of the experiments including the work on developing suitable performance indicators for the longer term. WP6 lead by Posiva included the quality assurance of the WP2-WP5 final summary reports by using expert elicitation as a means of independent peer review, promoted knowledge transfer with a staff exchange programme and integrated and summarized the project results in this report.
The DOPAS Project succeeded in improving the industrial feasibility of full-scale plugs and seals, the measurement of their characteristics, the control of their behaviour in repository conditions, and their performance with respect to safety objectives. The main outcomes of the DOPAS Project are that the experiments and the work carried out related the conceptual and basic design of the sealing structures in the participating countries enables the waste management programmes to move forward to the next level of technical maturity. In addition, the lessons learned described in detail in the work package and experiment summary reports provide valuable input also for waste management programmes needing further information to develop their own plugging and sealing solutions.

The main technical and scientific information is available at DOPAS Project Final Summary report, which is published as DOPAS Deliverable D6.4 at DOPAS website http://www.posiva.fi/en/dopas

Project Context and Objectives:
For all types of host rocks, geological disposal concepts include engineered barrier systems (EBS) made from specific technical structures, e.g. plugs and seals, consisting of engineered and natural materials that are designed to provide a range of isolation and containment functions. The plugs and seals may counteract to keep the already installed materials in place or they might provide tightness or separate two different type of groundwater areas from each other. Within IGD-TP (Implementing geological disposal - Technical platform) was raised a common need to study plugs and seals. For organisations achieving the licensing and implementation phase the driver was to support the development of reference design or alternative plug/seal designs for which detailed design needs to be available within the next few years. For organisations which have the licensing in future the primary driver for involvement in the DOPAS Project is to support long-term research and development (R&D) on the feasibility of geological disposal.

The main technical and scientific information is available at DOPAS Project Final Summary report, which is published as DOPAS Deliverable D6.4 at DOPAS website http://www.posiva.fi/en/dopas

Project Results:
The DOPAS Project focused on drift, vault, tunnel and shaft plugs and seals for clay, crystalline and salt rock environments. Following experiments were carried out: FSS seal by Andra and Nagra in France, EPSP plug by SURAO (former RAWRA) and CTU in the Czech Republic, DOMPLU and POPLU plugs in cooperation between SKB (Sweden) and Posiva (Finland) in their respective countries and ELSA project related experiment work in Germany by GRS and DBETEC. The main outcome was the demonstrators with increased knowledge in areas listed below

• Design basis processes: How are requirements on plugs and seals structured, and how can compliance with requirements be demonstrated? Can the learning from development of design bases for plugs and seals be applied to other repository elements?
• Conceptual designs of plugs and seals: What conceptual designs exist for plugs and seals and what are their roles within the overall safety concept?
• Plug and seal materials, and detailed design: The DOPAS Project addressed further development of plugs and seals materials, and the detailed design of the full-scale demonstration experiments.
• Siting and excavation of plug/seal locations: How are the locations of plugs and seals selected? Further development of methods for the excavation of plug and seal locations. What operational safety issues are posed by the excavation of plug and seal locations and how can one overcome these?
• Installation of plugs and seals: Further developments in the technology for emplacing plug and seal materials. What are the operational safety and logistical issues posed by the installation of plugs and seals?
• Monitoring of plugs and seals: Does suitable technology for monitoring the performance of plugs and seals exist. What are the issues with monitoring of plugs and seals?
• Performance of plugs and seals: How do plugs and seals perform with respect to detailed requirements on their performance?
• Compliance of plug and seal designs with their functions: To what extent can the current designs of plugs and seals be considered to meet their overall and safety functions?
• Project management during plug and seal construction and full-scale testing: What learning has the DOPAS Project provided with respect to the management of plug and seal implementation, conducting of full-scale tests and repository operations?
• Dissemination about and integration of learning on plugs and seals: Have the dissemination activities in the DOPAS Project been successful, and can the approaches adopted in the DOPAS Project be applied elsewhere?
• Technical readiness level of plugs and seals and remaining issues: What further development including testing of plugs and seals is required before designs are ready for implementation in operating repositories?
Potential Impact:
The main outcomes of the DOPAS Project are that the experiments and the work carried out related the conceptual and basic design of the sealing structures in the participating countries enables the waste management programmes to move forward to the next level of technical maturity. In addition, the lessons learned described in detail in the work package and experiment summary reports provide valuable input also for waste management programmes needing further information to develop their own plugging and sealing solutions.

The main dissemination outcome was to create and publish planned deliverables and organisation of DOPAS training workshop in September 2015 (12 participants) and DOPAS 2016 seminar in May 2016 (110 participants), and actively disseminate the progress and achievements of DOPAS Project work and Experiments for different target groups. The dissemination activities were planned and implemented according to the plan and the extent was greater than anticipated. Altogether, there were 94 dissemination activities and the DOPAS Project was highly visible among IGD-TP frames and in different seminars and conferences going beyond waste management area (e.g. concrete research and monitoring research). DOPAS Project published also 100 Deliverables and most of the were technical scientific in their nature and the main summary reports integrating achievements were quality assured by Expert Elicitation method.

More than 200 persons in 14 Participating organisation from 8 European countries have been working for DOPAS project.