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LUCOEX

Conference and Workshop



Full-scale demonstration tests in technology development of repositories for disposal of radioactive waste

Oskarshamn, Sweden
2nd – 4th June 2015

Attended by Kevin O'Donoghue and Rob McLaverty

SUMMARY

The LUCOEX End Conference and Workshop was attended by nuclear graduates Kevin O'Donoghue and Rob McLaverty. The event was held in Oskarshamn, Sweden, and was hosted by members of the LUCOEX project [1].

The aims of the conference were to cover all aspects of how to accomplish full-scale demonstration tests of repository concepts for the disposal of radioactive waste.

In addition to presentations from a number of waste management organisations (WMOs) and supply chain organisations, the event gave the nuclear graduates the chance to participate in a poster session, a panel session, and the chance to network with personnel from WMOs, experts and scholars.

On 4th June 2015 the two nuclear graduates took part in a visit to the Äspö Hard Rock Laboratory (HRL). In addition to viewing experiments that were undertaken as part of the LUCOEX project; the nuclear graduates were also able to view other experiments that had been undertaken by SKB. The nuclear graduates also had a tour of the Äspö Science Village which included visits to the Bentonite Laboratory, Chemistry Laboratory, Material Science Laboratory and the borehole deviation facility.

INTRODUCTION TO THE LUCOEX PROJECT

The vision of Europe's leading WMOs is that by 2025, the first geological disposal facility (GDF) for spent fuel (SF), high-level waste (HLW) and other long-lived radioactive wastes will be under operation. To achieve this goal, the European Atomic Energy Community (EURATOM), leading WMOs and research institutes are cooperating to create the necessary scientific foundations for these repositories [2].

WMOs from Sweden, Finland, France and Switzerland (as shown in Figure 1) have joined together as part of the EU funded 'Large Underground COnccept EXperiments' project to share the experiences and challenges they have faced as they demonstrate 'proof-of-concept' installations for a number of repository concepts.

Figure 1 Project partners from Sweden (SKB), Finland (Posiva), France (Andra) and Switzerland (Nagra)



The demonstration activities take place in four different underground research laboratories (URLs) in Europe which have been constructed for the purpose of

developing repository like technology under repository like conditions. The four repository concepts being addressed are:

- Horizontal disposal of waste packages in Opalinus Clay formation (managed by Nagra in the Mont Terri URL),
- Horizontal disposal of waste packages in Callovo-Oxfordian clay formation (managed by Andra in the Bure URL),
- Horizontal disposal of waste packages in hard crystalline rock (managed by SKB in the Äspö HRL) and,
- Vertical disposal of waste packages in hard crystalline rock (managed by Posiva in the Onkalo HRL),

The following technical issues are addressed as part of the LUCOEX project:

- Gallery construction,
- Manufacturing and emplacement of buffer around waste containers,
- Emplacement of waste packages and,
- Backfilling and sealing of galleries.

Results and achievements from the LUCOEX project are not only issues to the four project partners, but are also distributed to other interested parties through scholarships, conferences and workshops.

By sharing findings from the LUCOEX project, it allows lesser advanced WMOs (like our sponsor organisation Radioactive Waste Management Limited (RWM)) to benefit from these experiments and utilise results in their conceptual designs and forward development of their own GDF programme.

LUCOEX SCHOLARSHIP

The LUCOEX project includes active engagement in training and education in addition to engagement in the dissemination of project results. This engagement is expressed in the form of scholarships which cover travel, lodging and daily allowance to and from events. The scholarship program is aimed towards students, post-docs and engineers from EU Member States and Switzerland and requires their participation on workshops. Kevin O'Donoghue and Rob McLaverty were able to secure scholarships of €750 each to cover travel and lodgings for the event. Further expenses were covered by RWM. In receiving the scholarship, Kevin and Rob also agreed to participate in discussions during the 3 day conference and workshop, create a poster that would be presented during a poster session at the event, and produce a presentation for RWM that would be made to disseminate the results of the LUCOEX project so as to communicate the lessons that RWM could use and learn from – this presentation will be given in due course to RWM.

In addition to this, Rob McLaverty was also asked to give a presentation on the UK geological disposal programme and RWMs plans with relation to large and full-scale tests. Questions were then given to an expert panel as to how RWM could further utilise URLs like Äspö for UK specific experiments.

END CONFERENCE AND WORKSHOP

The conference and workshop was run over 2 days and was split in 5 sessions.

The 1st session consisted of presentations by SKB, Posiva, Nagra and Andra which gave an overview of their geological disposal programmes and their current status. Comments were made on the challenges with respect to license applications, the remaining plans and challenges for proof of concept installations and the challenges associated with stakeholder engagement during a siting process.

The 2nd session consisted of 12 presentations that covered the planning and installation activities of full-scale demonstration testing from the LUCOEX project, in addition to other projects associated with geological disposal such as the **Demonstration Of Plugs And Seals (DOPAS)** and the **MO**nitoring **DE**velopments for **Safe Repository Operation aNd Staged Closure (MODERN)**. The session highlighted the importance of full-scale testing and their basis for the optimisation of technologies. It was also noted that in-situ tests are expensive, but are necessary to recognise weaknesses in repository concepts designs. All large scale experiments that were presented faced a delay of some sort – the reasons behind these delays will be of upmost importance when planning for future experiments and GDF construction.

The 3rd session consisted of 4 presentations regarding experience that have been gained during the excavation of tunnels and drifts in URLs at Mont Terri, Bure and Äspö. The session expanded on state of the art techniques for tunnel excavation in addition to novel techniques such as wire sawing. The session also reiterated that careful analysis of geological environments at a site are needed to avoid 'surprises' i.e. faults, anisotropy of rock formations.

The 4th session consisted of 6 presentations which focussed on the lessons learnt with respect to different production techniques for granular and bentonite blocks which are used as backfill and buffer materials in a variety of repository concepts. The session highlighted the importance of regulating the environment during production as humidity was found to have a major influence on the quality of the bentonite. Quality assurance was deemed as vital for block quality and should be set as part of further technological developments.

The 5th and final session consisted of 5 presentations. 1 focussed on the utilisation of LUCOEX results for other WMOs and highlighted the value that the results provide with respect to the development of the respective GDF programmes. The other 4 presentations were from 4 organisations which covered the status of their programmes and their programmes plans related to large and full-scale tests. The 4 organisations were SURAO from Czech Republic, PURAM from Hungary, INR from Romania and RWM from the UK. Robert McLaverty represented RWM during this session and gave a presentation regarding the new UK White Paper [3] on implementing geological disposal and examples of how URL experiments in Äspö have helped RWM. This is shown in Figure 2. Rob was then able to give a question to an expert panel regarding how organisations like RWM can maximise the benefit of developing specific UK experiments in a URL such as Äspö.

Figure 2

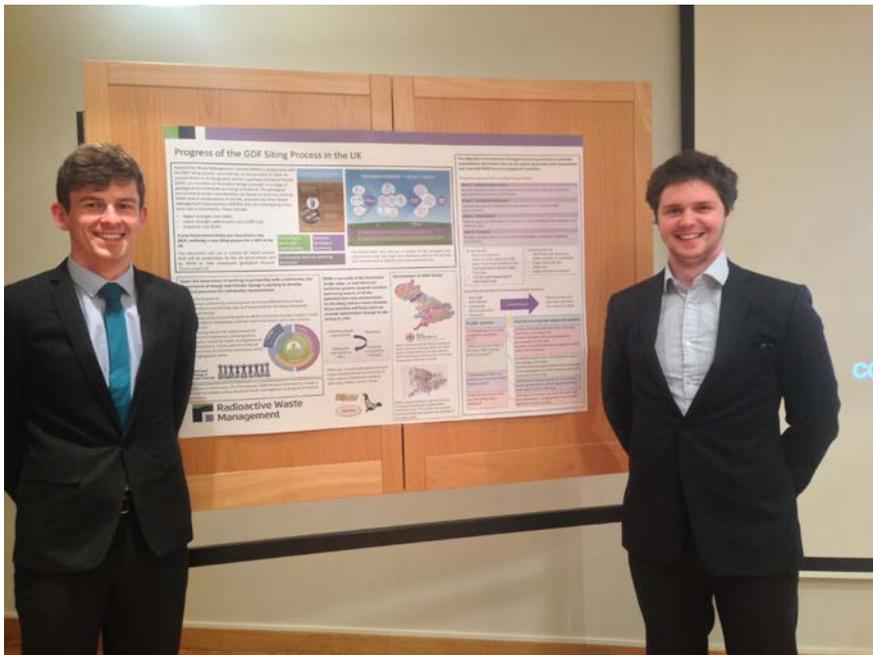
Rob McLaverty presenting at LUCOEX End Conference and Workshop



In addition to these 5 sessions, there was also a poster session which provided complementary information and details to some of the messages and presentations that were given during the conference and workshop. Kevin O'Donoghue and Rob McLaverty created a poster which supplemented Rob's presentation in session five and gave an overview of the current status of the GDF siting process within the UK. This is shown in Figure 3. The nuclear graduates were able to answer questions posed about the UK siting process and explain the initial actions of the 2014 White Paper which were detailed on the poster.

Figure 3

Kevin O'Donoghue and Rob McLaverty with the RWM Poster at LUCOEX



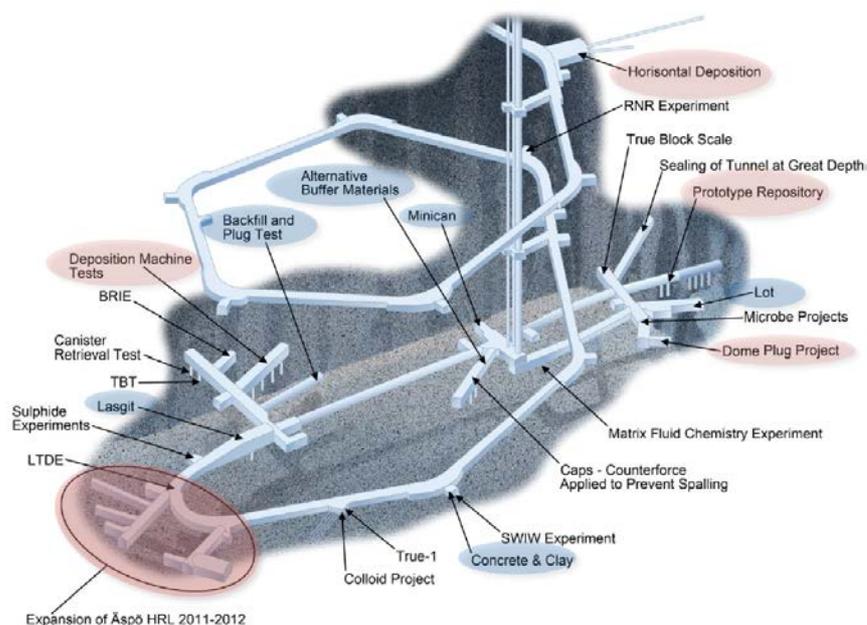
ÄSPÖ HRL & SCIENCE VILLAGE TOUR

In addition to the conference and workshop, a visit to the Äspö HRL was also organised by SKB. This included a visit underground to look at the range of experiments that are being carried out at Äspö and a tour around the Äspö Science Village:

- Experiments that were seen underground included the prototype repository, the dome plug (DOMPLU) project and the KBS-3H concept. There was also a demonstration of the deposition machine that is to be used for the KBS-3V concept. The experiments that were seen are shown in Figure 4. In addition, we were also able to see where a demonstration of some wire sawing had been undertaken underground. During the visit, the nucleargraduates were able to query certain parameters of the experiments with the aim of taking this reasoning and learning back to RWM to inform them further. The visit also gave the nucleargraduates an appreciation for the work that is currently being undertaken in URLs and the impact that this work can have towards the ultimate implementation of a GDF.
- A number of facilities were visited as part of the Äspö Science Village tour and these included the Bentonite Laboratory, Material Science Laboratory, Chemistry Laboratory and a facility for testing borehole deviation equipment and methodology.

In addition to taking on board the results from the LUCOEX experiments, the nucleargraduates were also able to network with personnel from SKB, Nagra, Andra, the European Commission and the supply chain and make a number of useful contacts.

Figure 4 Experiments seen during Äspö HRL visit (highlighted in red)



CONCLUSIONS

The LUCOEX End Conference and Workshop gave the nucleargraduates a good insight into the work ongoing as part of the LUCOEX project and some of the results that had been obtained. This was not limited to LUCOEX but also included projects such as DOPAS. With these results in mind, the nucleargraduates are now able to return to RWM and share their learning and experiences with the aim of helping RWM to utilise some of the results that have been obtained as part of the LUCOEX project. This should help RWM further develop their conceptual designs with respect to the underground facilities of a GDF. The event also gave the nucleargraduates an excellent platform to develop their soft skills through the poster session, the presentation and through networking with experts and scholars. Finally, the visit to the Äspö HRL gave the nucleargraduates an appreciation for the sheer scale and size of a potential GDF, the current scope of work that is ongoing to help implement a GDF, and the amount of work that still must be done to further establish application licenses and safety cases for the construction and operation of a GDF.



REFERENCES

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- ³ DECC. *Implementing Geological Disposal: A framework for the long-term management of higher activity radioactive waste*. URN 14D/235. 2014.