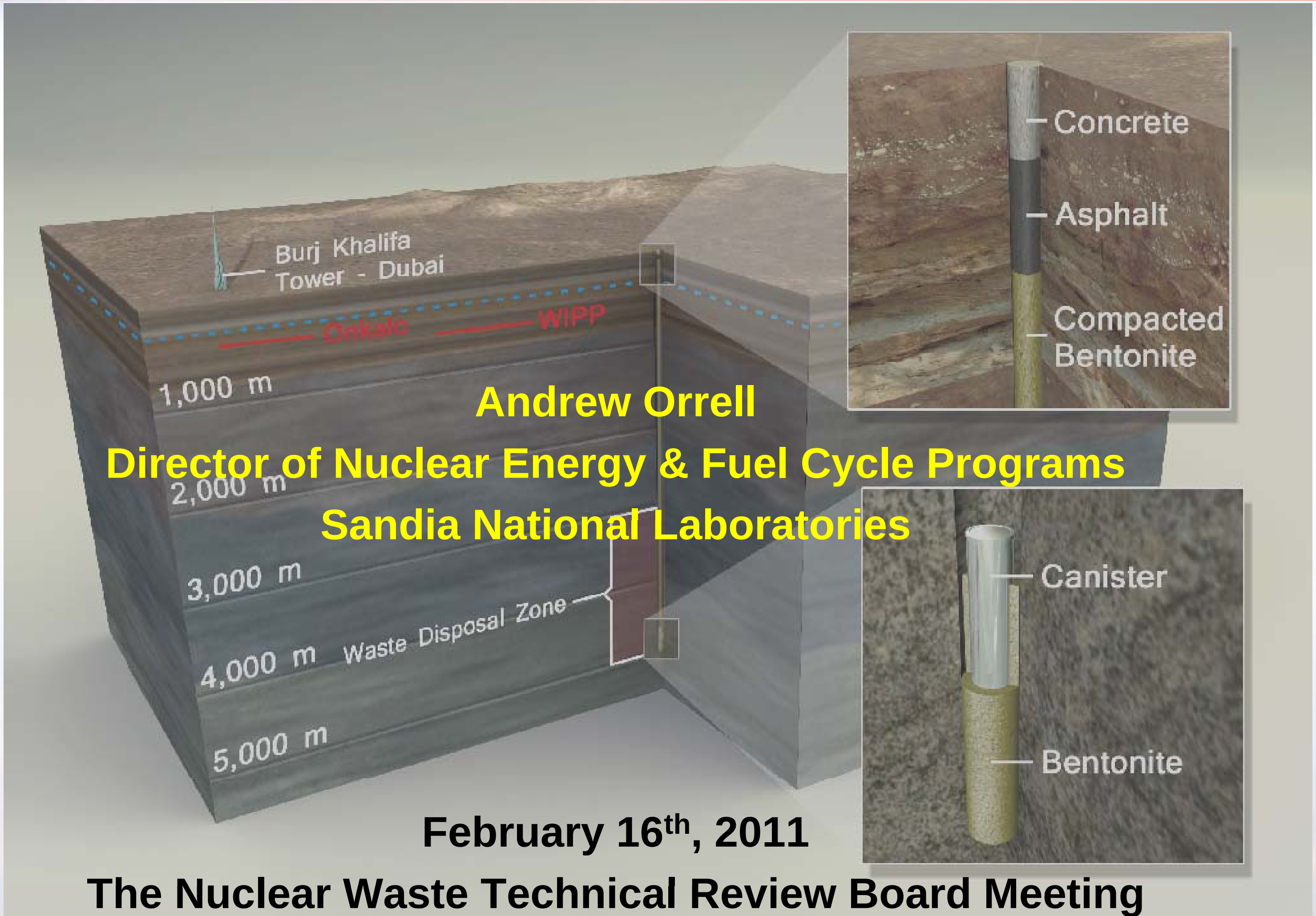
Deep Borehole Disposal: Programmatic Drivers and Pilot Demonstration Path Forward



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The Nuclear Waste Technical Review Board Meeting

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SAND 2011-0936P

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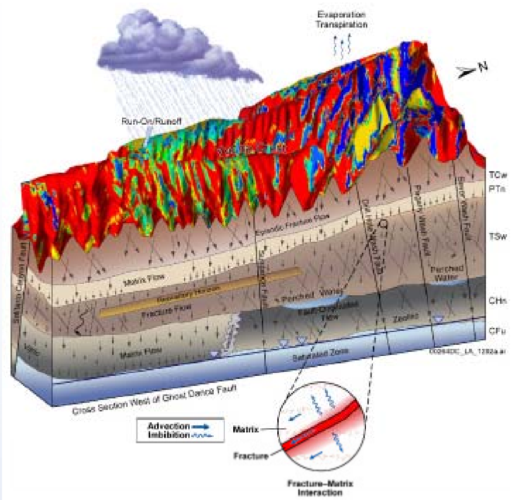
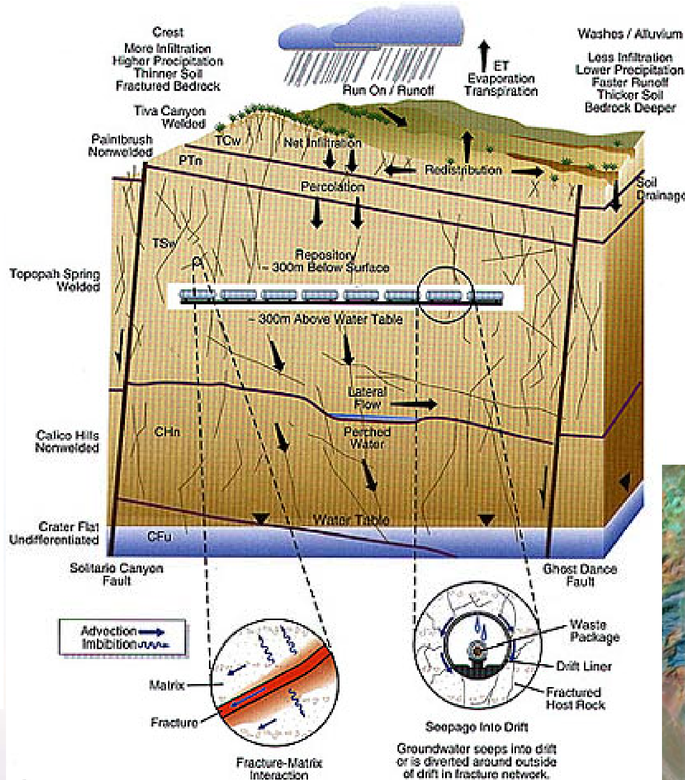
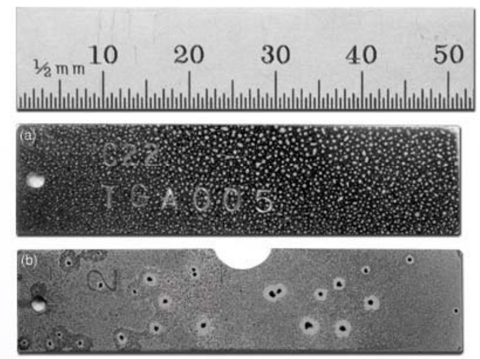
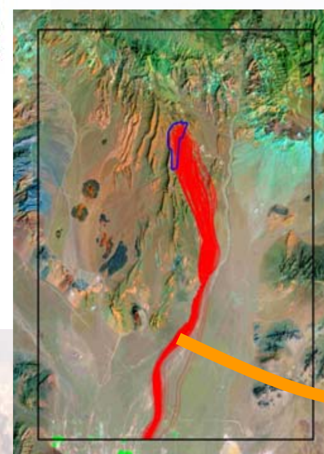
Mined Repositories

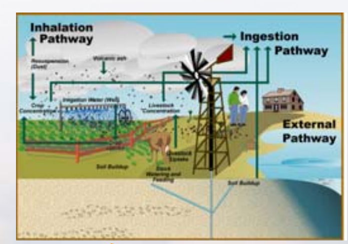
- **Coupling between the surface and near-field disposal environment**



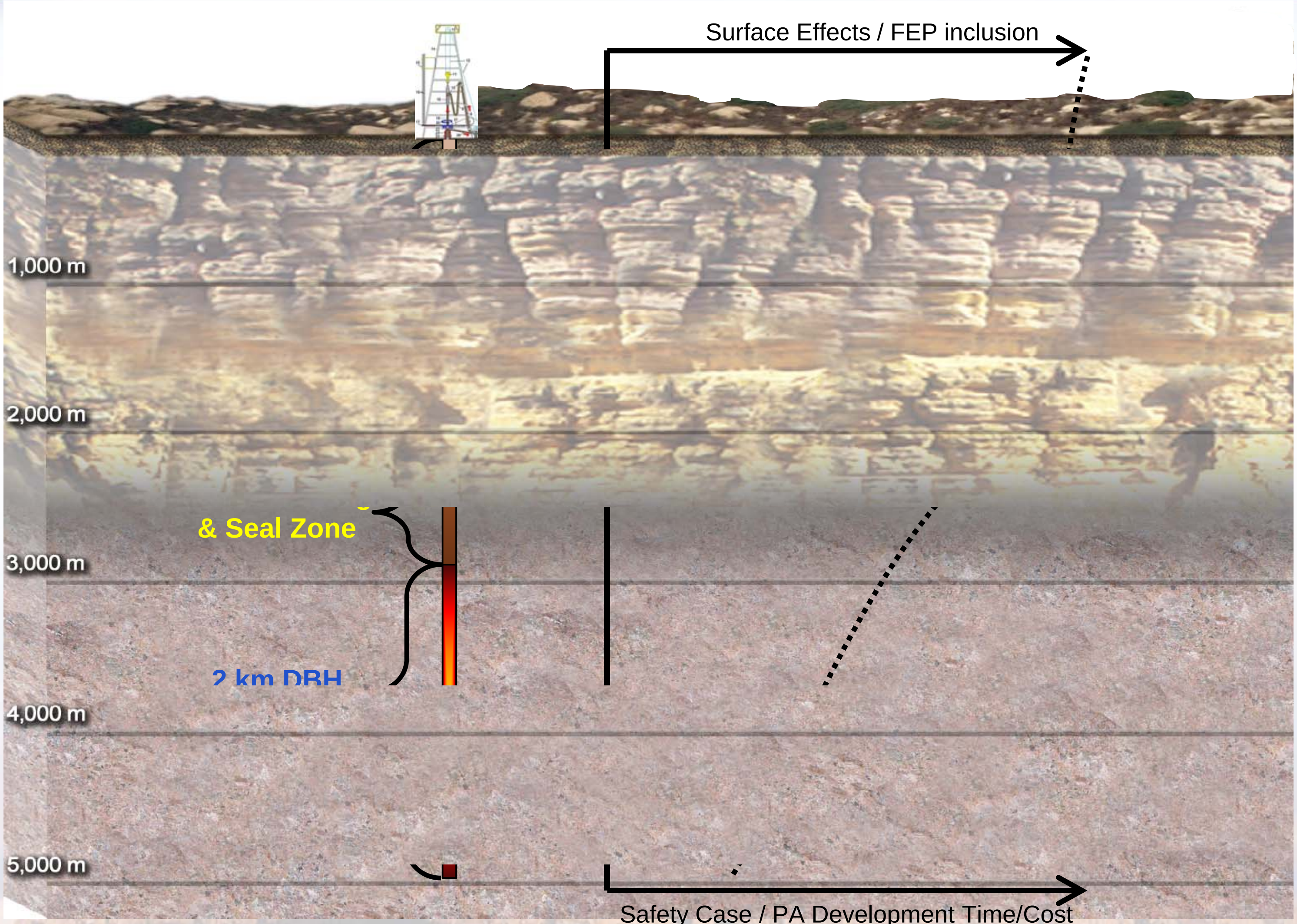




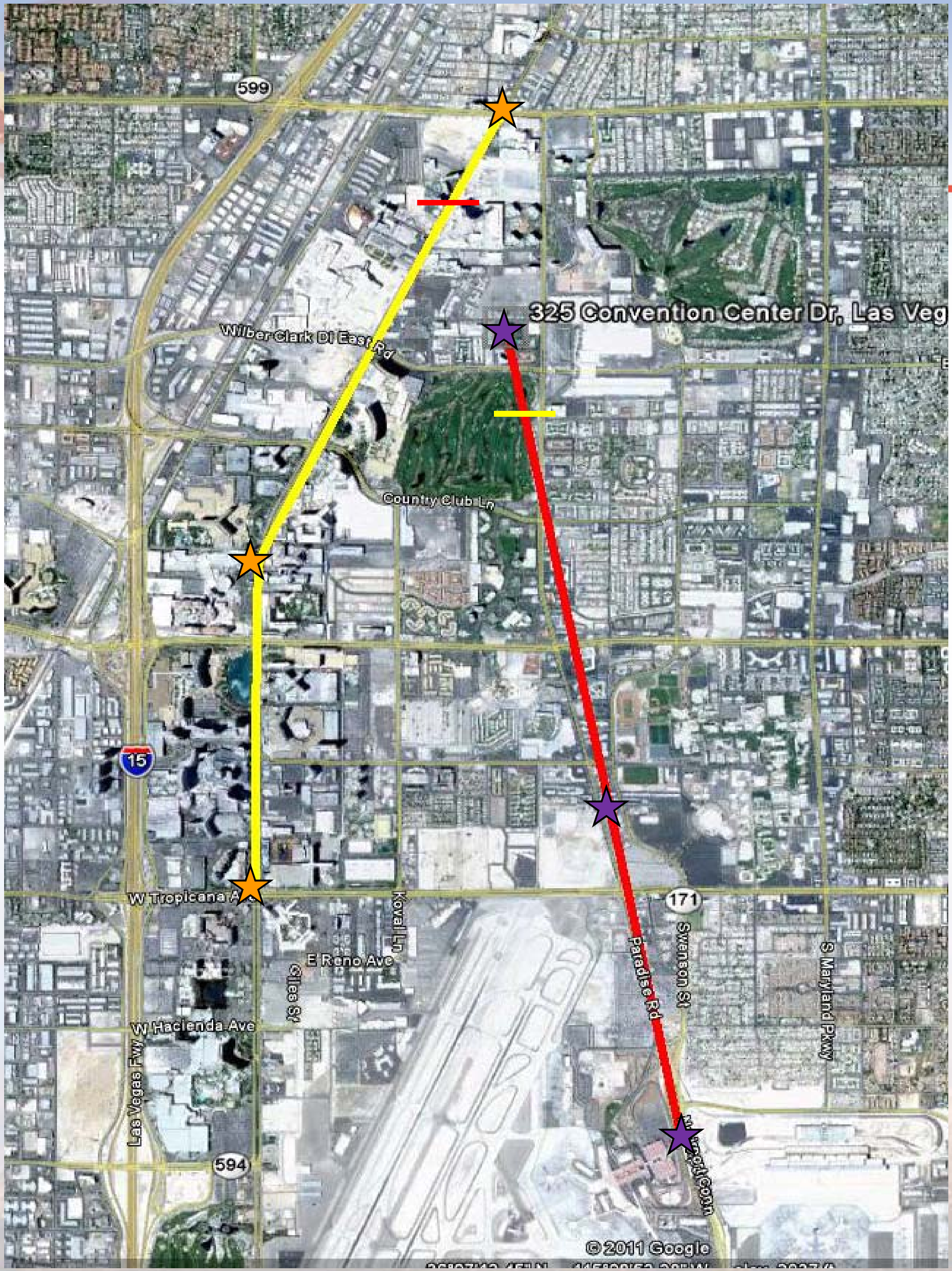




Deep Borehole Disposal Concept Drivers



5 km Paths



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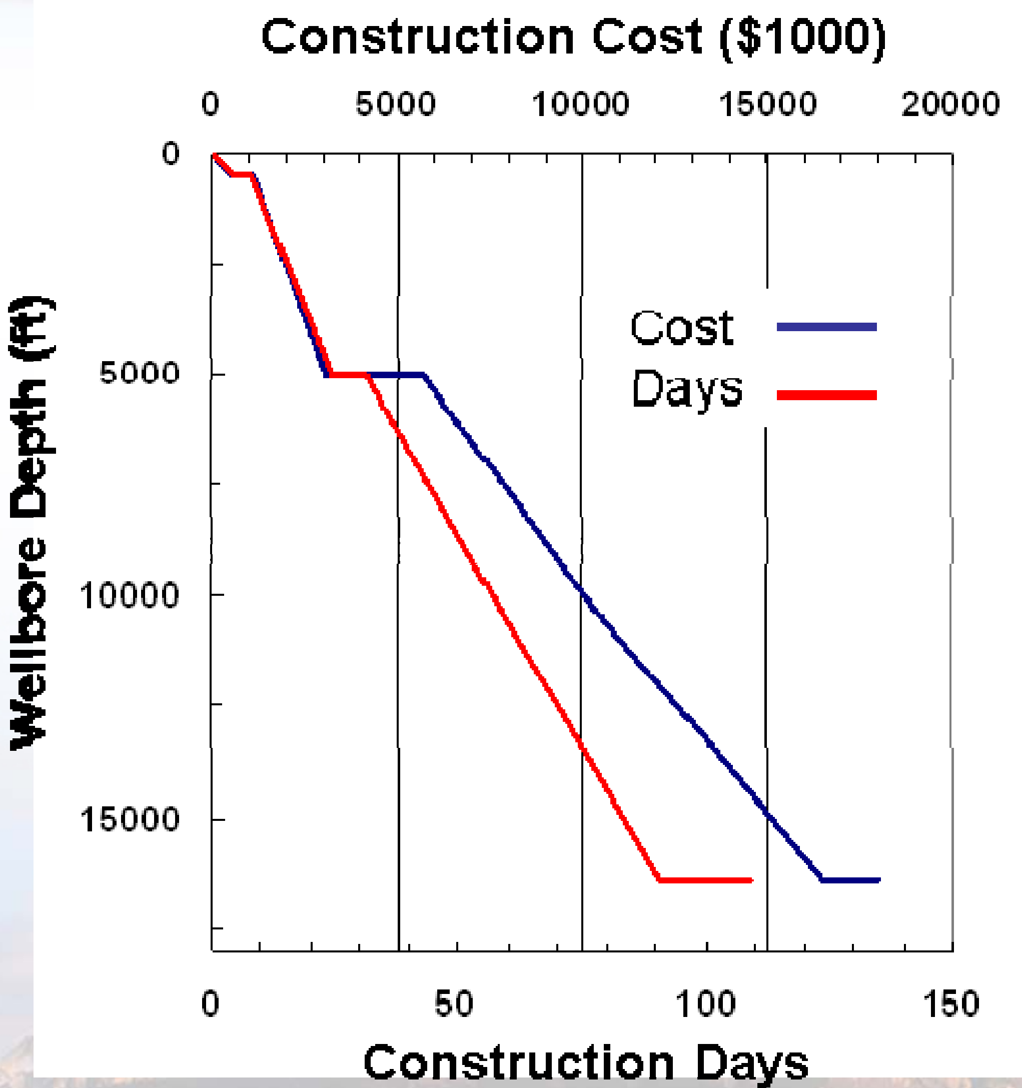
Asserted Benefits of DBH Disposal Concepts

- **Crystalline basement rocks are relatively common at depths of 2 km to 5km**
- **Disposal could occur at multiple locations, reducing waste transportation costs and risks**
  - Greater potential for site to site performance comparability, possibly avoiding 'best site' contentions, fostering equity and fairness issues.
- **Low permeability and high salinity in the deep crystalline basement suggest extremely limited interaction with shallow groundwater resources; high assurance isolation**
- **Thermal loading issues are minimized**
- **Geochemically reducing conditions limit solubility and enhance the sorption of many radionuclides**
- **Retrievability is difficult**
- **Compatible with multiple waste forms and types (e.g. CANDU bundles)**
- **The deep borehole disposal concept is modular, with construction and operational costs scaling approximately linearly with waste inventory**
- **Existing drilling technology permits construction of boreholes at a cost of about $20 million each**
  - Low cost facilitates abandonment of emplacement-ready holes that fail to meet minimum criteria, limits 'make it work' perceptions
- **Disposal capacity of ~950 boreholes would allow disposal of projected US SNF inventory**
  - Dry Rod Consolidation (demonstrated at INL in the 80's) could reduce this by ~1/2, or possibly further reduce costs for smaller hole bottom diameter
- **May be amenable to a COL approach (separate licensing for technology and siting)**

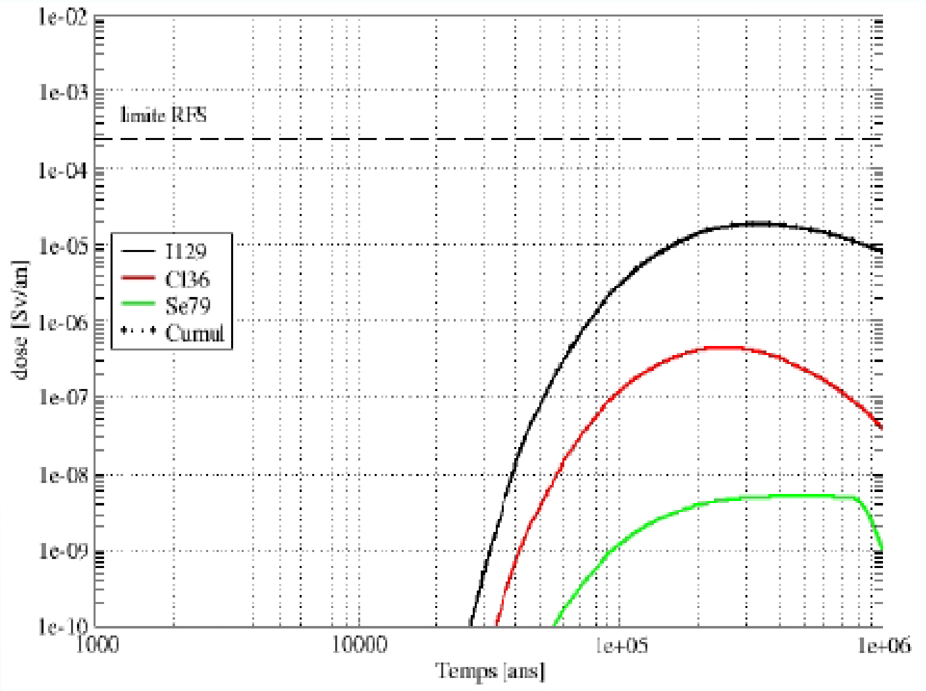
Source: Brady, P.V., B.W. Arnold, G.A. Freeze, P.N. Swift, S.J. Bauer, J.L. Kanney, R.P. Rechard, J.S. Stein, 2009, *Deep Borehole Disposal of High-Level Radioactive Waste,* SAND2009-4401, Sandia National Laboratories, Albuquerque, NM, and Technology and Policy Aspects of Deep Borehole Nuclear Waste Disposal, M. J. Driscoll, R. K. Lester, K. G. Jensen (MIT), B. W. Arnold, P. N. Swift, and P. V. Brady (SNL)

Feasibility

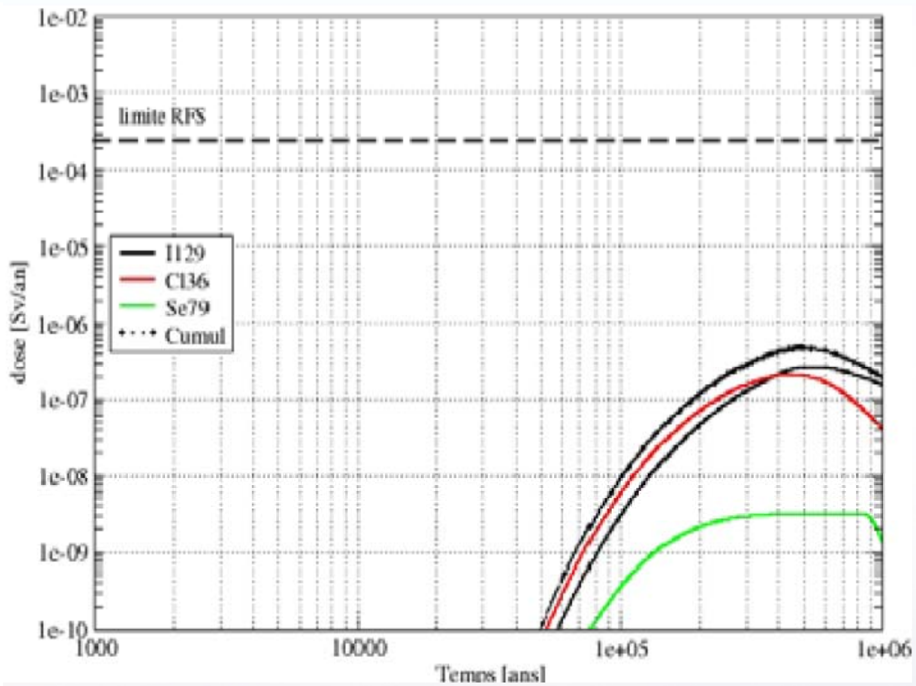


Source: Polsky, Y., L. Capuano, et al. (2008). *Enhanced Geothermal Systems (EGS) Well Construction Technology Evaluation Report,* SAND2008-7866, Sandia National Laboratories, Albuquerque, NM

Two Repositories



ANDRA 2005, *Dossier 2005: Argile. Tome: Evaluation of the Feasibility of a Geological Repository in an Argillaceous Formation*, Figure 5.5-18, SEN million year model, CU1 spent nuclear fuel



ANDRA 2005, *Dossier 2005: Argile. Tome: Evaluation of the Feasibility of a Geological Repository in an Argillaceous Formation*, Figure 5.5-22, SEN million year model, C1+C2 vitrified waste

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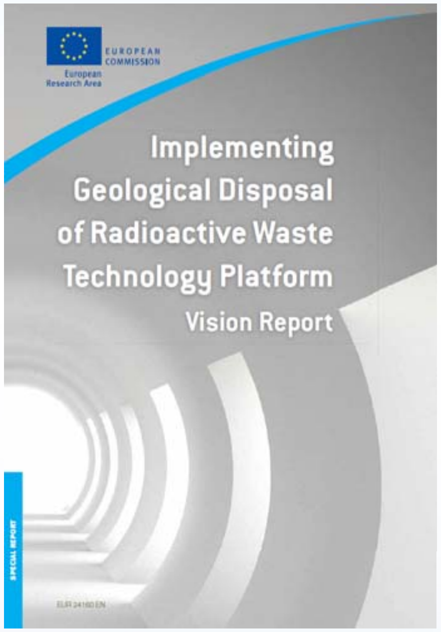
Next Steps



http://www.igdtp.eu/

“Our vision is that by 2025, the first geological disposal facilities for spent fuel, high-level waste, and other long-lived radioactive waste will be operating safely in Europe.”

Sets the RD&D priorities for licencing and implementation

Deployment Plan expected 2011, to lay out forms of joint work and activities, leads, etc.

Can we create a DBH Disposal Technology Platform as a consortium of interested *implementers*, dedicated to resolving the remaining R&D needed for implementation of a pilot demonstration?

Conclusion

- The point here is not that Deep Borehole Disposal is the best or only solution for geologic disposal. The point is that the concept holds such significant promise that it warrants consideration of an effort to accelerate its pilot demonstration, and to vet its true feasibility and viability.
- As the concept has such merit for the US, and potentially Mexico and Canada as well, it may be worth considering a multinational collaborative effort similar to the EU technology platform for Implementing Geologic Disposal.
- Lastly, as a concept which could yield patentable technology that would have direct and indirect applications (e.g. enhanced geothermal), industry RD&D participation is conceivable, and could be a precursor to alternative waste management models such as FedCorp.