DOPAS

DOPAS Training Workshop 2015

The Application of DOPAS Lessons Learnt to Less Advanced Waste Management Programmes

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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 for the DOPAS project.

Radioactive Waste Management Ltd (RWM)

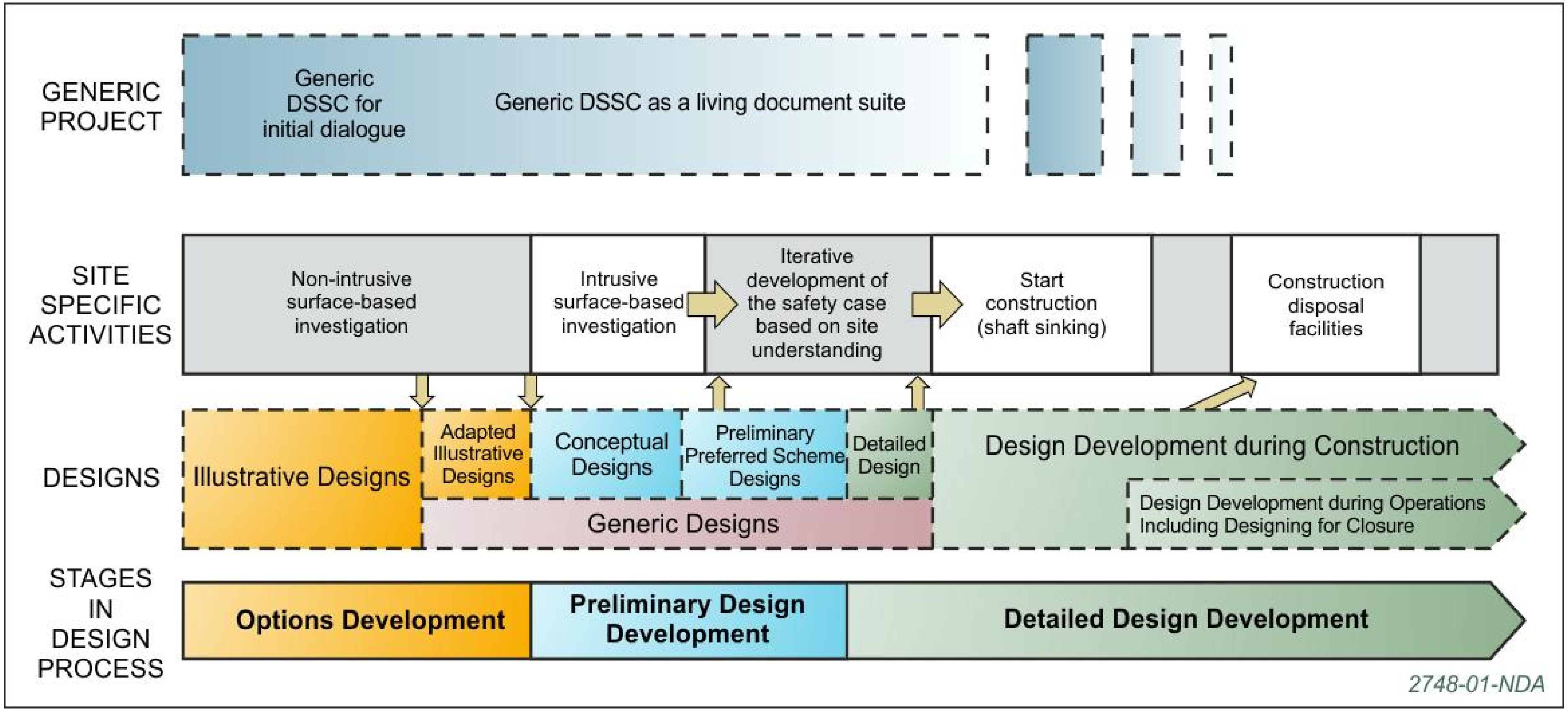
- Radioactive Waste Management Limited (RWM) is a wholly owned subsidiary of Nuclear Decommissioning Authority (NDA).

- RWMs mission is to deliver a geological disposal facility and provide radioactive waste management solutions.

- In the near term this includes:
  - Engagement with national and local governments and communities to identify a geological disposal site; and
  - In conjunction with waste producers, identify and deliver solutions to optimise the management of higher activity waste.

- 2014 White Paper ‘Implementing Geological Disposal’ – An ‘enabling’ document

Engineering Design Development Stages – Generic Stage



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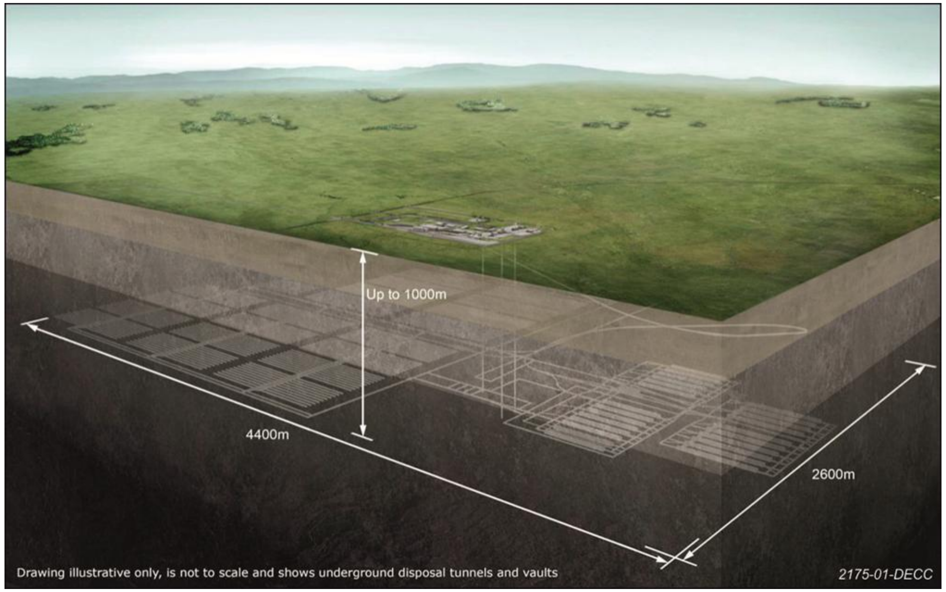
Geological Disposal

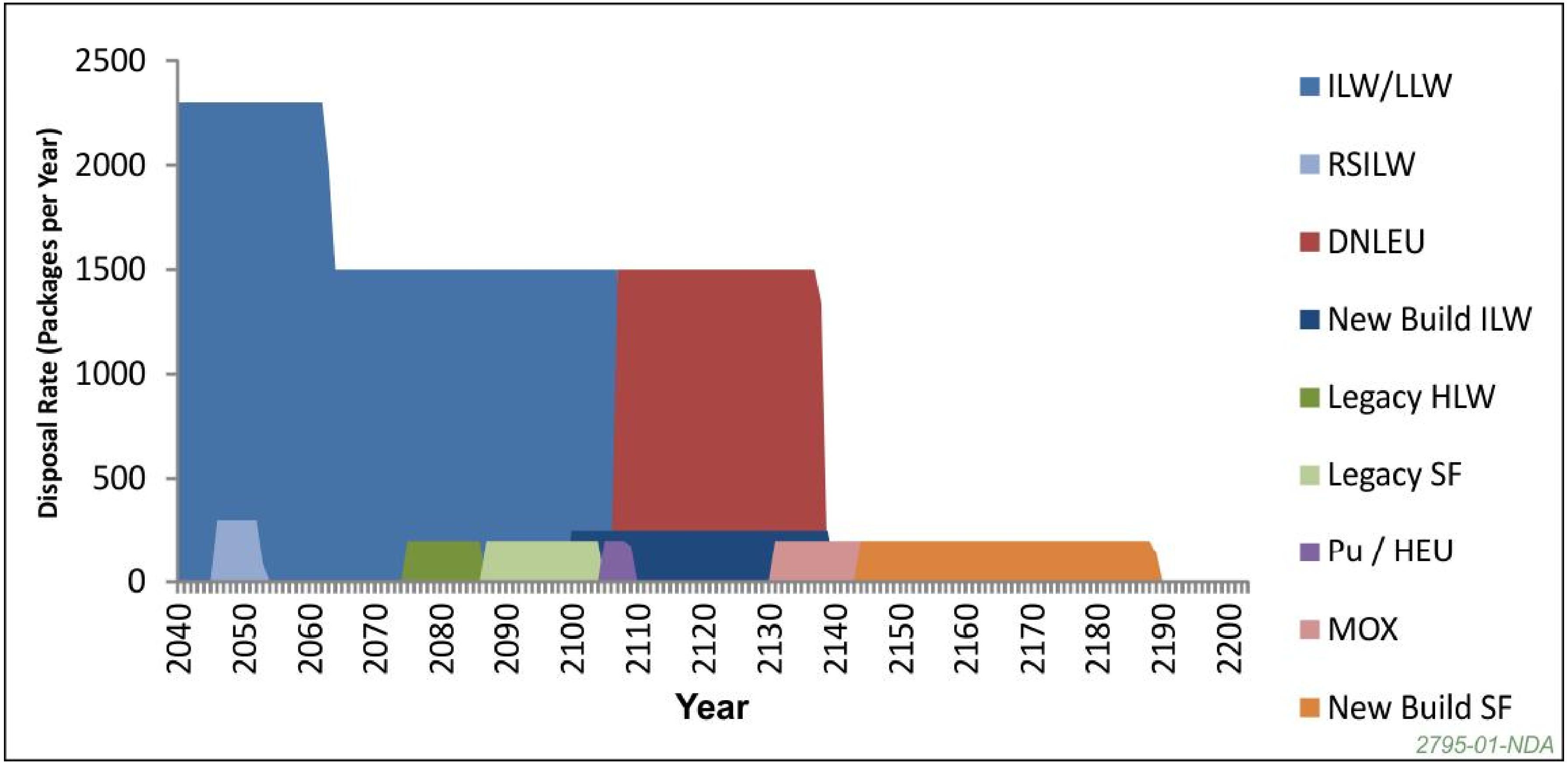
- ISOLATES radioactivity from surface
- CONTAINS until hazard has decayed
- Provides passively safe system

Needs:

- Suitable geological environment and
- a willing community



GDF* Waste Emplacement Timings – 160 Year Operational Period



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* Geological disposal facility

Geological environments

© SKB Äspö Hard Rock Laboratory – Sweden

© ANDRA underground test and research site – Bure, France

© DoE - Waste Isolation Pilot Plant

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Sources of illustrative geological disposal concepts for host geological environments and classes of waste

Host rock	Illustrative Geological Disposal Concept Examples[d]	
	LHGW	HHGW
Higher strength rocks[a]	UK LHGW Concept *(RWM, UK)*	KBS-3V Concept *(SKB, Sweden)*
Lower strength sedimentary rock[b]	Opalinus Clay Concept *(Nagra, Switzerland)*	Opalinus Clay Concept *(Nagra, Switzerland)*
Evaporites[c]	WIPP Bedded Salt Concept *(US-DOE, USA)*	Gorleben Salt Dome Concept *(DBE-Technology, Germany)*

Geological disposal – 2014 White Paper overview

© DECC

- National Geological Screening (RWM)
- Preparing to work with communities (DECC)
- Developing land-use planning processes (DECC)

Initial Action: National Geological Screening (RWM)

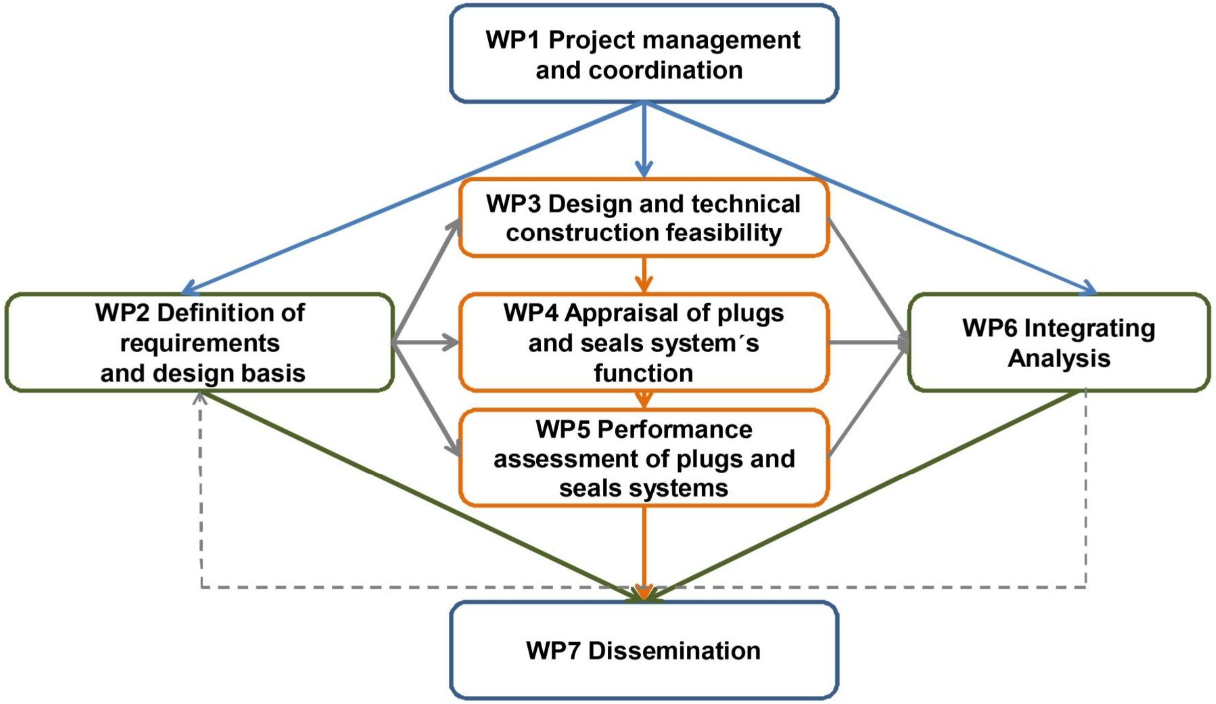
- **The objective of the National Geological Screening exercise is to provide authoritative information that can be used in discussions with communities and may help RWM focus its engagement activities**

- **Screening will:**
  - focus on long-term environmental safety of a GDF
  - draw on the requirements in the existing Disposal System Safety Case
  - consider existing geological information only

- **Screening will not:**
  - definitively rule all areas as either ‘suitable’ or ‘unsuitable’
  - target individual sites
  - select sites
  - replace statutory processes

RWMs role in DOPAS

- The integrated report will present a synthesis of the learning gained from the installation and commissioning of the full-scale tests (DOMPLU, POPLU, EPSP and FSS).



Current RWM Strategy for Plugging and Sealing

- **Higher Strength Rock**

Low-permeability seals consisting of highly compacted bentonite retained by a concrete structure would be constructed to isolate vault modules, disposal areas, shafts and the drift.

- **Lower Strength Sedimentary Rock**

Highly compacted bentonite and a concrete bulkhead. Seals would retain backfill materials within the disposal vaults and tunnels and also minimise the potential for radionuclide migration in the long term.

- **Evaporite Rock**

Rigid concrete wall with contact grouting around the concrete component, as required. 15 – 30m apart within the disposal tunnel.

Disposal System Technical Specification

- RWM currently captures requirements in the disposal system technical specification (DSTS). The following requirements are related to disposal areas:

- Where appropriate, backfilling equipment shall be segregated from the waste disposal areas of the facility and the number of operational interfaces between disposal areas and backfill equipment shall be minimised.

- After backfilling of the disposal areas, each disposal module shall be sealed through installation of a Sealing Plug, which shall be designed to:
  - provide mechanical support to the backfill material in a disposal module and be strong enough to withstand the combined pressure from the groundwater and any swelling of the backfill and buffer materials;
  - limit water flow from a disposal module to the access ways;
  - consider requirements on gas migration from a disposal module into the access ways.

Safety Functions and Requirements (1)

- The safety functions of plugs and seals differ between programmes, depending on the geological environment, disposal concept and approach to safety case development.

- However, typical safety functions include:
  - Confinement of tunnel backfill
  - Prevention of groundwater flow through waste disposal areas
  - Prevention of access to the repository after closure.

- Short term vs. long term safety functions.

- As mentioned, in the UK we have three generic illustrative designs for three potential host environments; higher strength rock, lower strength sedimentary rock and evaporite rock.

Safety Functions and Requirements (2)

Higher Strength Rock:

• Aim to achieve a hydraulic conductivity comparable to that of the rock mass, ensuring a good contact is established between the plug/seal and the host rock.

Lower Strength Sedimentary Rock:

• Need to ensure that low hydraulic conductivities are achieved to match those of the clay. Removal of host rock lining may become necessary in this regard.

Evaporite Rock:

• All seals must be introduced in such a way that brine migration through the artificial openings to the waste packages is avoided until the backfill is sufficiently compacted (creep).

Conceptual Design(s) – Plugs/Seals

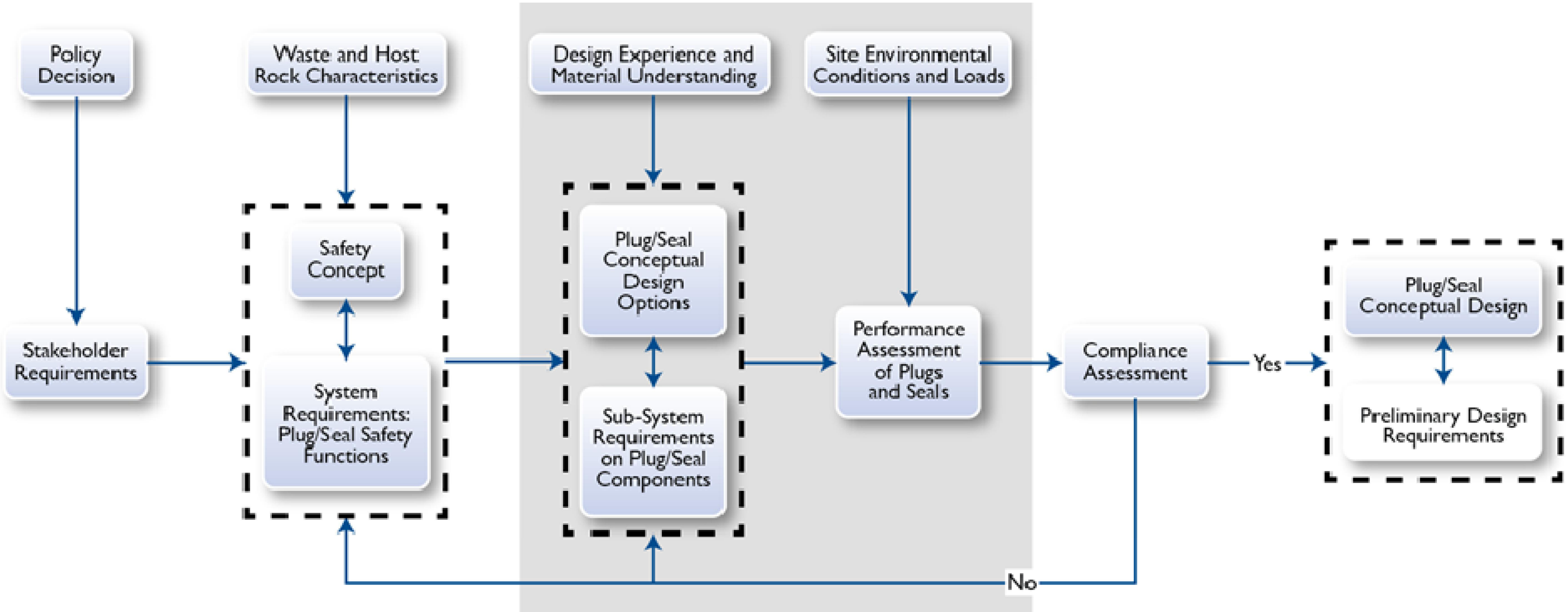
• Currently a level of detail which we do not have in our current illustrative designs.

• Designs for plugs and seals are significantly more complex than currently accounted for in RWMs generic illustrative designs, where specific sub-system components required to deliver the safety functions (e.g. filters and delimiters).

• Plugs and seals tailored to deliver different safety functions for a specific type of host rock. (However, at RWM the term is used at a high level across all geologies).

• The design of plugs and seals is dependent on the boundary conditions, therefore it is difficult to design without out site specific information.

Conceptual Design – Process Flow



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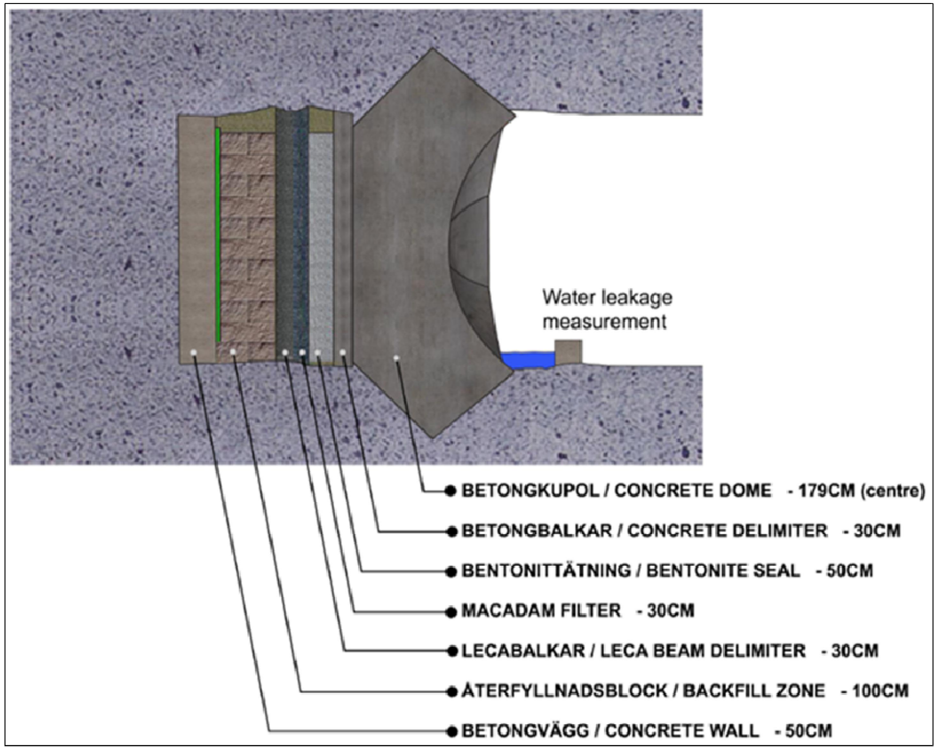
Basis for Conceptual Designs Summary



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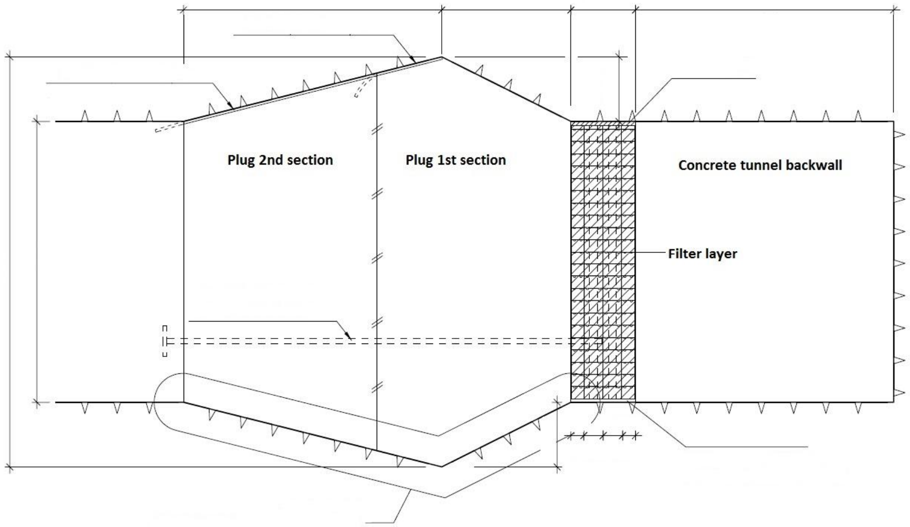

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Basis for Conceptual Designs

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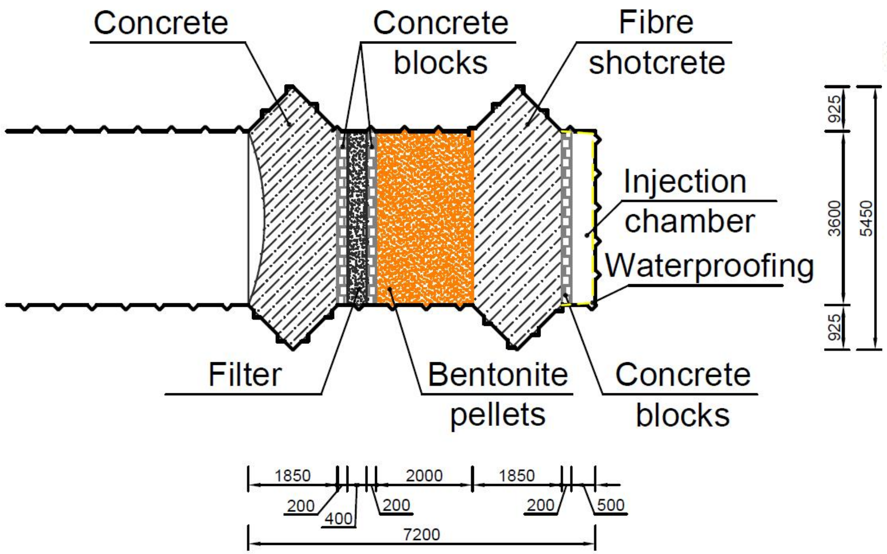

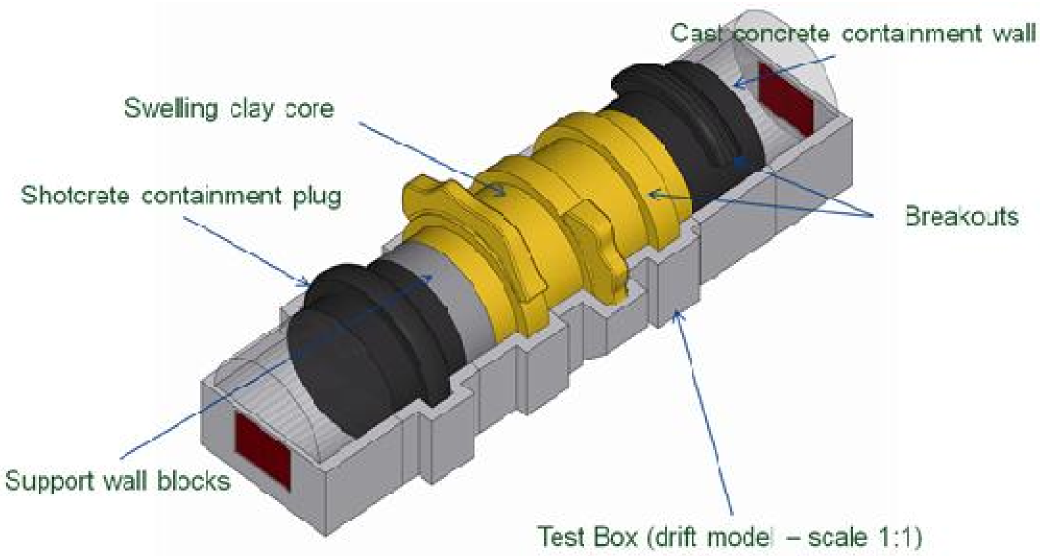

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High Level Design Assumptions

- Tunnel Cross Sections to be kept to a minimum
- Low Permeability plugs/seals
- Reinforced Concrete Plugs
- Seal composition – Bentonite
- Location of plugs and seals – 1 plug every 100m
- 40m long plug placed in main disposal facility accesses
- Operating plugs and permanent plugs

High Level Design Assumptions

Operating Plugs

	Dimensions (m)	Cross Section (m^2)	Thickness (m)	Volume of Concrete (m^3)	Mass of Reinforcement (kg)
Operating Plug	5.5 wide x 5.5 high	25	5	40,000	
Retaining Wall	5.5 wide x 5.5 high		0.3	2400	
Retaining wall reinforcement			1000kg		320,000

Permanent Plugs

	Dimensions (m)	Cross Section (m^2)	Thickness (m)	Volume of Concrete (m^3)	Mass of Reinforcement (kg)
Permanent Plugs	5.5 wide x 5.5 high	25	10	4,000	
Retaining Wall	5.5 wide x 5.5 high	25	0.3	120	
Retaining Wall Reinforcement				1000	16,000

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Technology

- Engineered Barrier Materials
- Excavation techniques – Wire Sawing (occupational safety)
- Concrete Recipes – low pH - Impact on near-field performance
- Impact of operational and post closure safety on design of plugs and seals
- Monitoring of plugs and seals
- Achieving the required density

Conclusion

- RWM is currently in a generic stage of work, therefore designs are at a high level.

- Participation in DOPAS has allowed RWM to develop and enhance its knowledge of plugging and sealing.

- Work is currently ongoing with our supply chain to apply the lessons learnt from DOPAS to the UK Programme.

- This work will result in updates to RWM GDF design report and to the Disposal System Technical Specification.

- Further work on the application of lessons learnt from the DOPAS project will be presented during the DOPAS Seminar 2016.

Thank you – Any Questions?

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References

1. Radioactive Waste Management Limited, Corporate Strategy 2015 – 2018.

2. Department for Energy and Climate Change, White Paper: Implementing Geological Disposal, 2014.

3. NDA RWMD, Geological Disposal – Generic disposal facility designs, NDA/RWMD/048, December 2010.

4. NDA RWMD, Geological Disposal: Disposal System Technical Specification, NDA/RWMD/044, November 2010.

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