



DOPAS

Training Workshop 2015



D1 1.3.2

Scoping the DOMPLU experiment at Äspö HRL

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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.



Outline of this lecture

1. Information about the DOMPLU experiment

- Objectives (partially based on requirements)
- Experimental layout
- Photos from installation
- Example of results and conclusions

2. Scoping a technical development project

- Useful tool: Work Breakdown Structure (WBS)
- Group work: Create a WBS for the DOMPLU full scale experiment



Part 1 – Information about DOMPLU



The DOMPLU experiment

- **DOMPLU is a full-scale test of the plug system in realistic conditions at Äspö HRL (-450 m) with 4 MPa water pressure in the deposition tunnel.**



Acknowledgement

- **DOMPLU is conducted as a joint project between SKB and Posiva. Correspondingly, SKB takes part of Posiva's plug project POPLU in ONKALO.**



- **Both DOMPLU and POPLU are part of the Full-Scale Demonstration Of Plugs And Seals (DOPAS) project.**

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More info can be found at the Dopas website: www.posiva.fi/dopas



DOMPLU objectives (major)

- **Construction of a dome plug system according to design specifications (SKB TR-10-16) in the license application.**
- **Improve the plug design and verify quality control of installation and commissioning in full-scale.**
- **Control water tightness of the plug. Recent analyses allow a maximum leakage of <math><0.1\text{ l/min}</math> past the plug. (SKB TR-14-22, in preparation)**

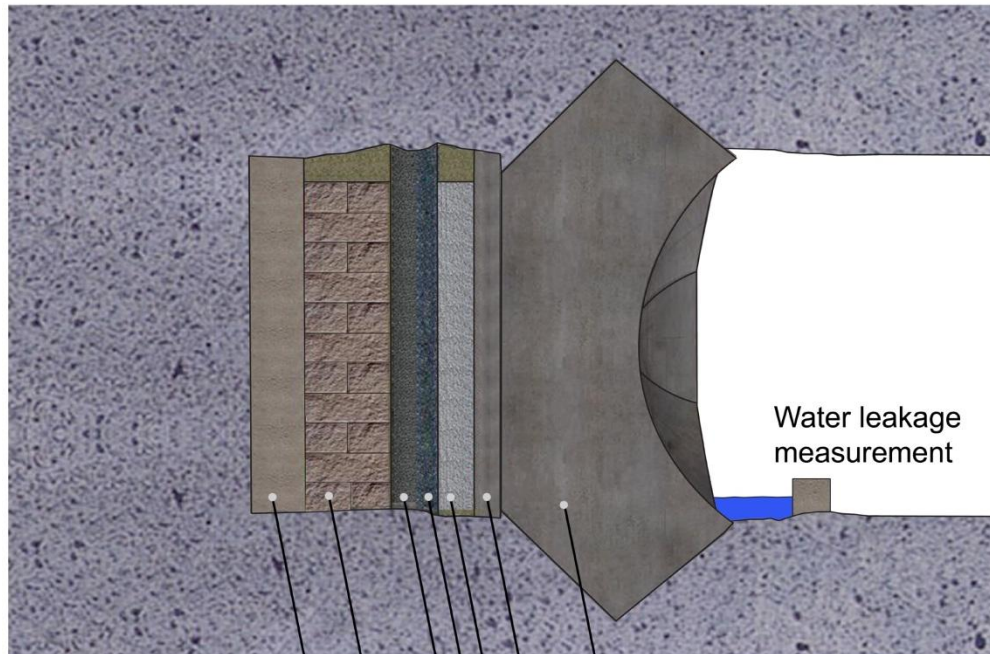


Preparations before full-scale

- **Laboratory tests of plug component materials:**
 - Filter/Drainage (gravel in different fractions, geotextiles, LECA)
 - Bentonite Seal, MX-80 blocks and pellets
 - Low-pH Concrete, recipe B200 (SKB R-09-07)
- **Analytical and Numerical calculations for design purposes and full-scale test predictions**
 - Hydro-Mechanical modelling of Bentonite Seal – Filter - Backfill
 - Thermal and structural responses of the Concrete Dome
- **Downscaled (1:10) tests of the plug system (6 trial cycles)**
- **Äspö HRL field-tests (slot excavation, contact grouting)**
- **Pilot borehole core characterisation and water injections**



DOMPLU layout



48 sensors in the bentonite seal, filter and backfill
Total and pore pressures, RH & temperatures, displacements.

- BETONGKUPOL / CONCRETE DOME - 179CM (centre)
- BETONGBALKAR / CONCRETE DELIMITER - 30CM
- BENTONITTÄTNING / BENTONITE SEAL - 50CM
- MACADAM FILTER - 30CM
- LECABALKAR / LECA BEAM DELIMITER - 30CM
- ÅTERFYLLNADSBLOCK / BACKFILL ZONE - 100CM
- BETONGVÄGG / CONCRETE WALL - 50CM

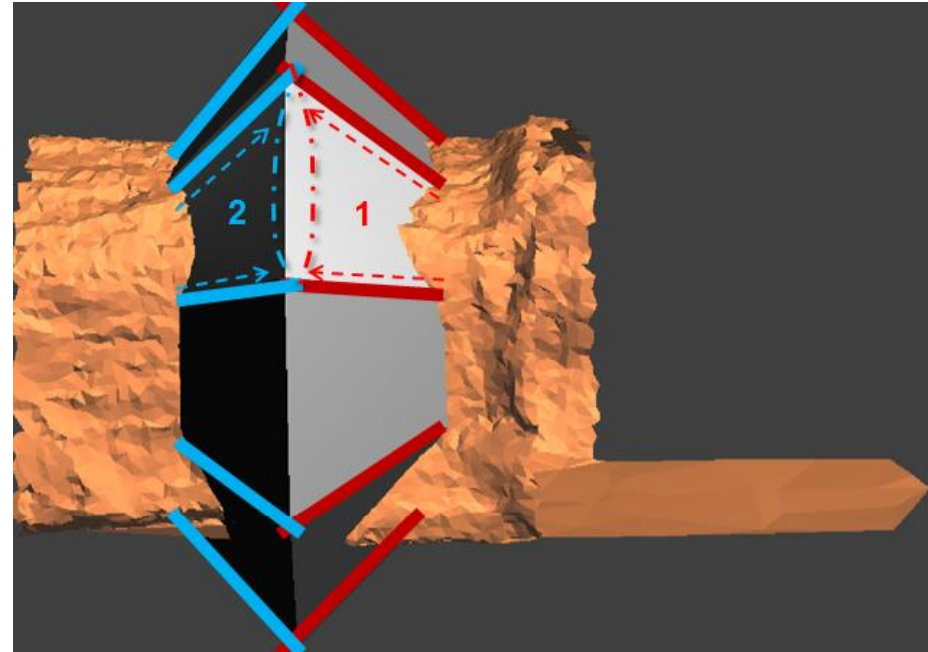
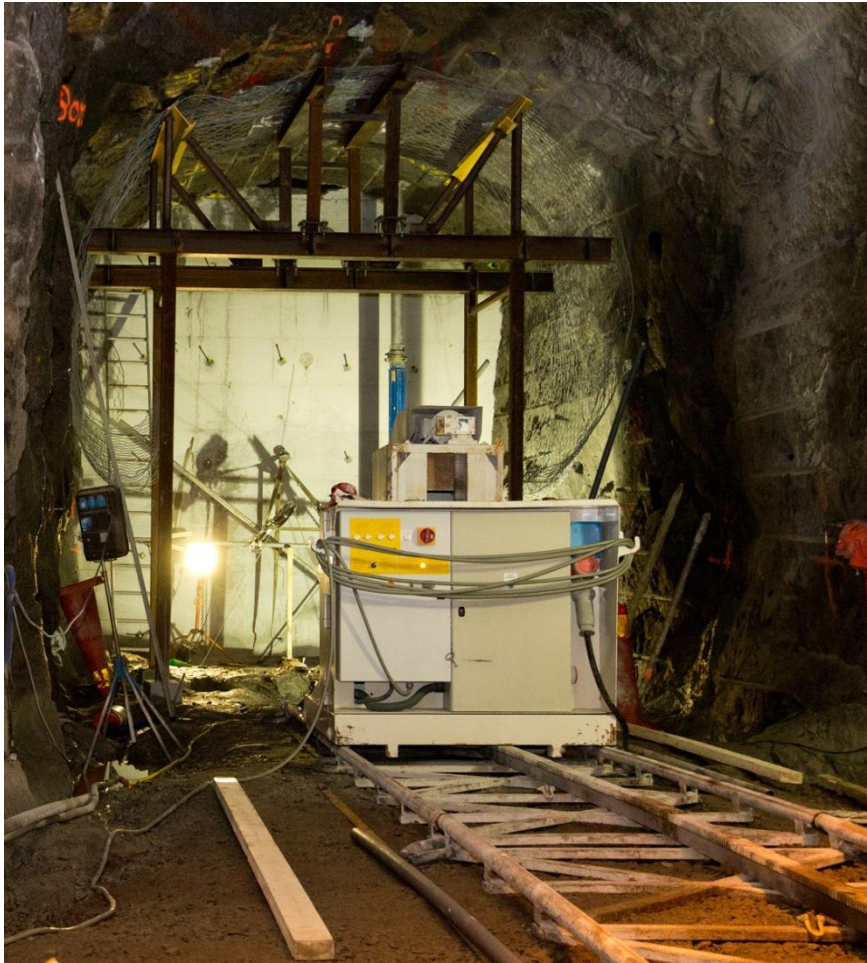
56 sensors in the concrete dome
Gap-width, deformation, strains and temperatures.

3 supplementary sensors in the lead-through pipe and the drainpipes
Pore pressures



Monitoring of leakage
On-line scale

Slot excavation by wire sawing



- Symmetrical octagon design (16 cuts, \varnothing 8.8 m)
- Safety scaffold structure for workers protection



The excavated slot



- **View of the excavated slot for casing of the concrete dome**

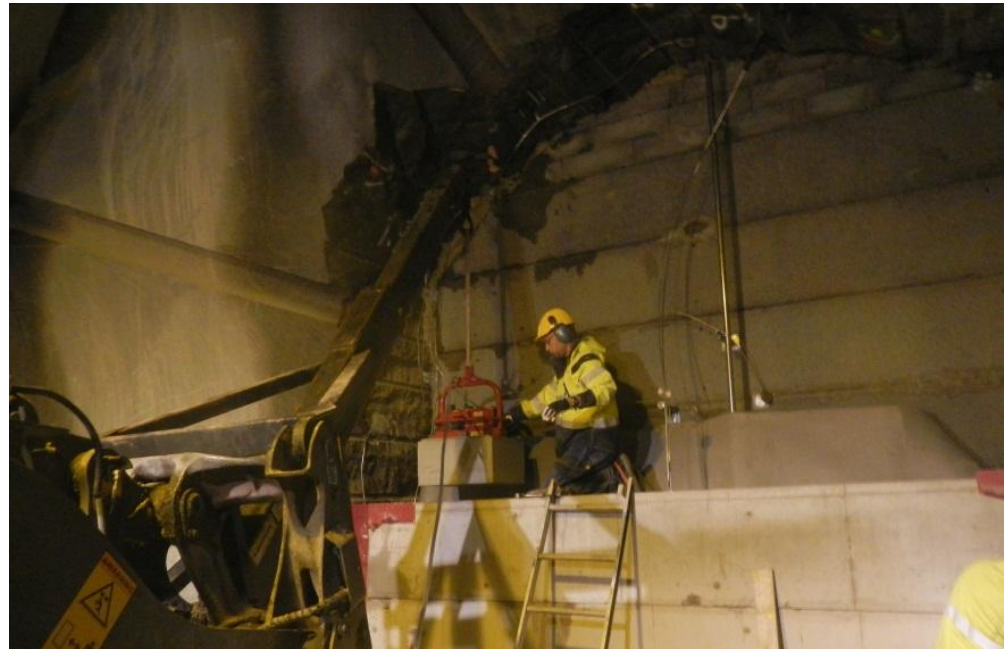
- **Model composed of laser scanning data**



Installation 1 (3)



- **3 lead-through pipes for sensor cabling and water inlet pipes**
 - **Backfill blocks/pellets and LECA beams**
 - **Gravel filter, bentonite seal (MX-80 blocks/pellets) and concrete beams**



Installation 2 (3)

- Grouting tubes (3 sections)
- Geotextile (2 layers)



- Concrete sensors
- Cooling system



Installation 3 (3)



- **Formwork (by Doka)**
- **Casting (94 m³ B200)**
 - § **Non-reinforced structure**



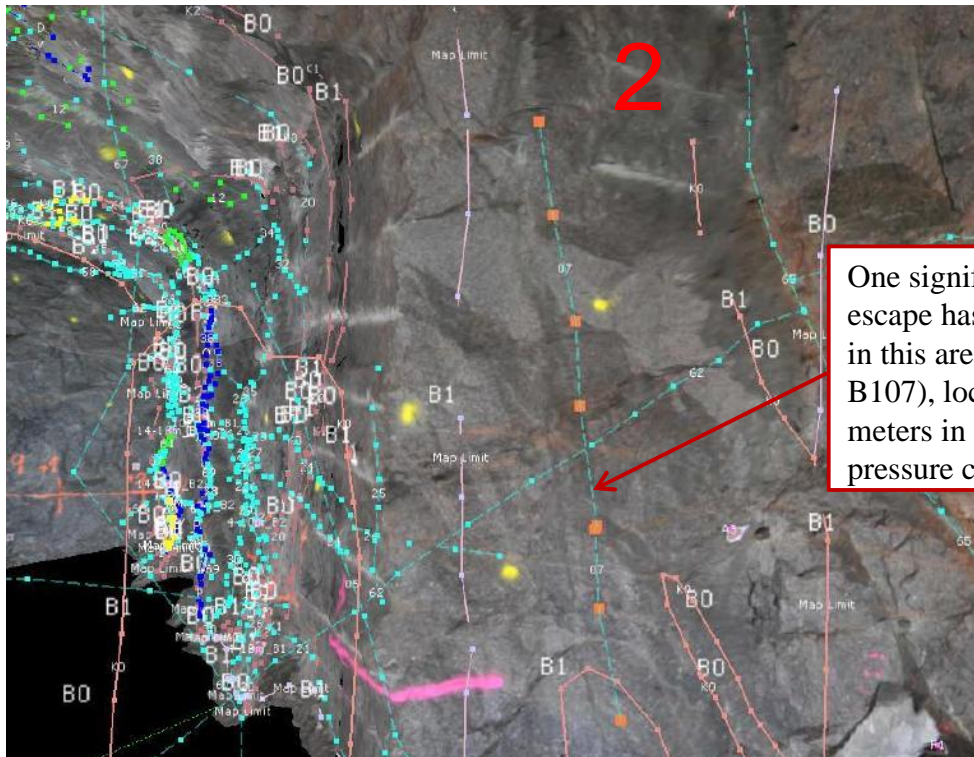
- **Chillers (redundant)**

DOMPLU in operation



- **Monitoring have been carried out since March 2013.**
- **Full water pressure 4 MPa was reached in February 2014.**
- **Data freeze for the DOPAS project: September 30, 2014.**
- **On-line leakage measurements.**
- **Plastic sheet reduces effects of tunnel ventilation and evaporation.**

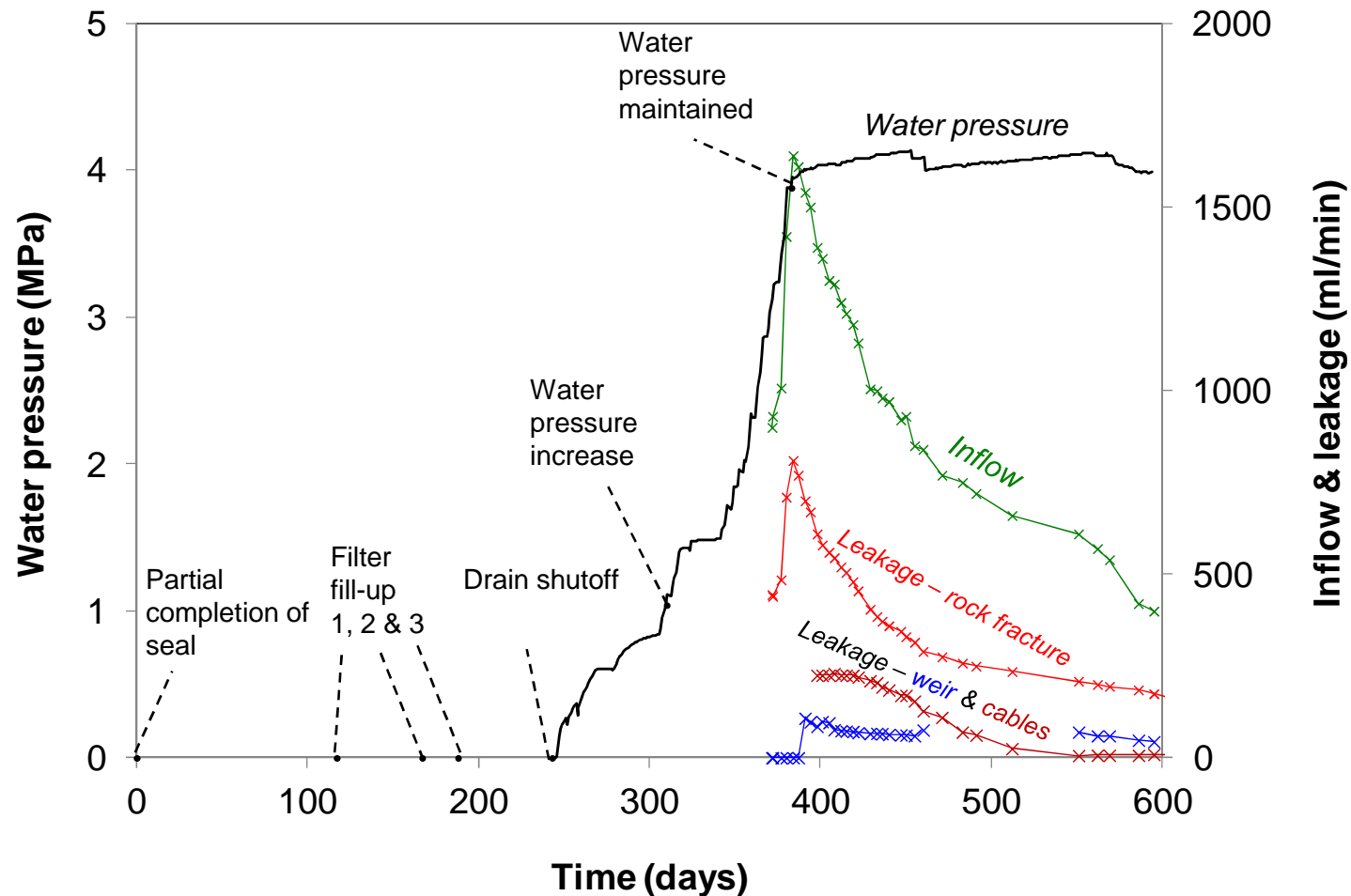
Water escapes



One significant water escape has been identified in this area (fracture B107), located about 14 meters in front of the pressure chamber

1. Cables
2. Rock fracture
3. Plug/Rock interface

Water inflow and leakage trends



September 30, 2014: The measured leakage past the plug (in weir) was **0.04 l/min** at 4 MPa water pressure (this was about 11% of the inflow)

Conclusions (in selection)

- In general, plug construction was successful and workers safety aspects were handled in a good way. Learnings: Formwork can be redesigned, installations at tunnel ceiling can be improved.
- Initially, all sensors worked well. A few sensors failed during contact grouting and other sensors have failed due to water pressure increase.
- Sensors data correspond very well to predictive calculations.
- The plug is tighter than the rock!
- The leakage past the plug (collected in the weir) is well below 0.1 l/min and the trend is decreasing. Seal is not yet saturated.



DOMPLU coming work

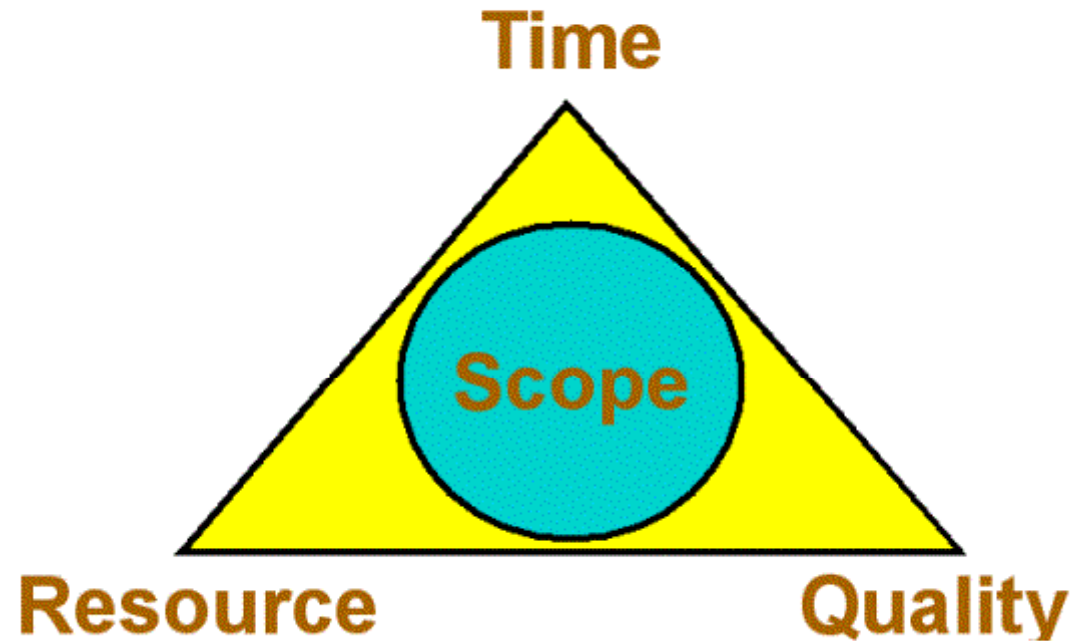
- **Technical reporting. DOPAS deliverable D4.3**
- **DOMPLU results will lead to a “light update” of the basic design of deposition tunnel plugs in the Spent Fuel Repository.**
- **Operation and monitoring of DOMPLU will continue at 4 MPa water pressure, at least until late 2016**
- **DOMPLU will be opened and retrieved in 2017. A final load test (close to the design load of 9 MPa) is a unique opportunity to verify the design of the concrete dome and the numerical models used.**



DOMPLU publications

- SKB P-13-37 System design of Dome plug. Creep properties at high stress levels of concrete for deposition tunnel plugs. (published)
- SKB P-13-38 System design of Dome plug. Mechanical properties of rock-concrete interface (published)
- SKB P-14-26 Experience of low-pH concrete mix B200. Material properties from laboratory tests and full-scale castings (in preparation)
- SKB R-14-24 System design of Dome Plug. Experiences from wire sawing of a slot abutment for the KBS-3V deposition tunnel plug (in preparation)
- SKB R-14-25 System design of Dome Plug. Preparatory modelling and tests of the sealing and draining components (in preparation)
- KTH TRITA-BKN147 Instrumentation and Evaluation of the Concrete Dome Plug.
- **SKB TR-14-23 System design and full-scale testing of the Dome Plug for KBS-3V deposition tunnels. Main report (in preparation)**

Part 2 – Scope Management



Determining the scope

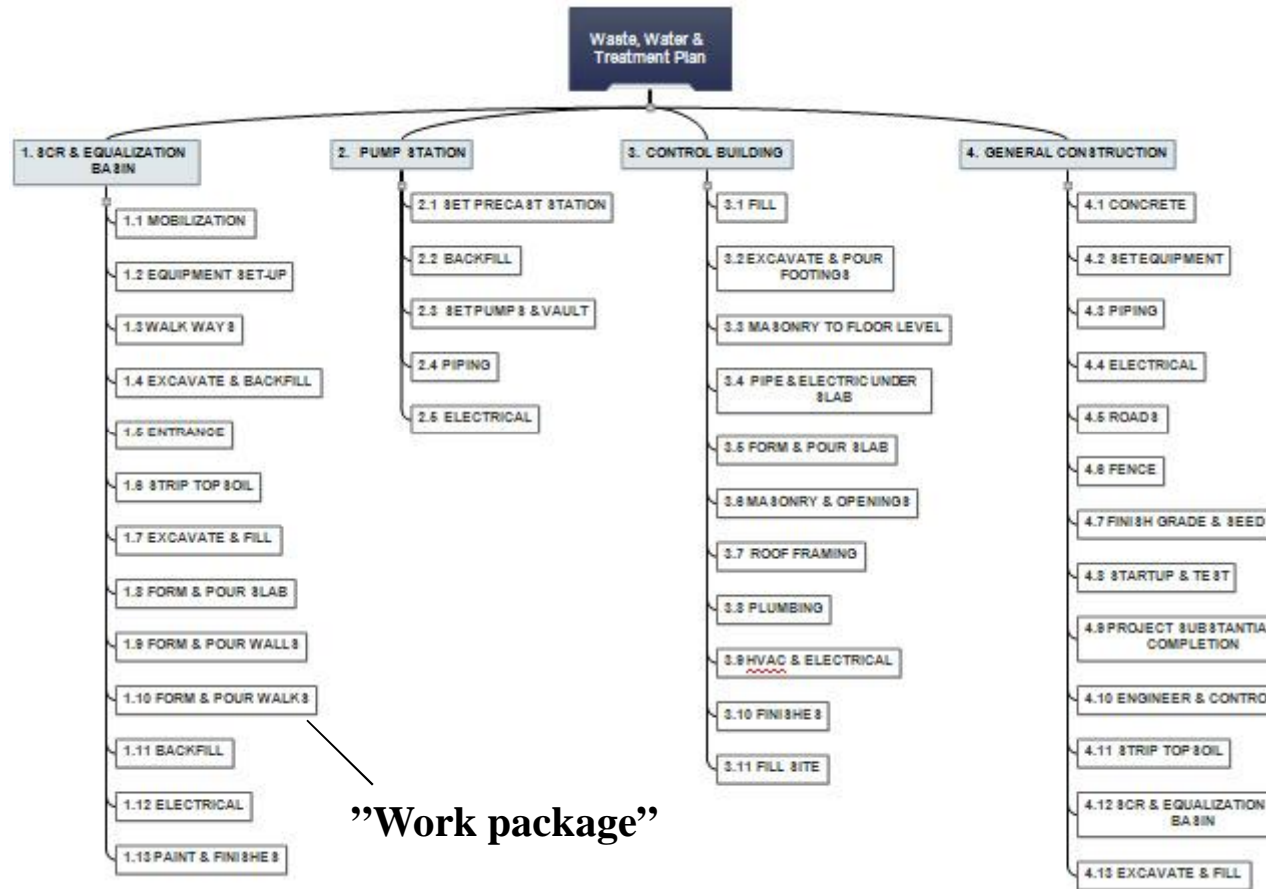
- An essential part of the project planning is to define a scope statement.
- Correct and proper breakdown of the scope is essential for a successful project (i.e. to fulfil the project objectives and meet the Client's expectation on the deliveries).
- Subdivision of major project deliveries should be done in a Work Breakdown Structure (WBS). *

- *
 - ISO 21500 Guidance on project management
 - ISO 10006 Guideline to Quality in project management
 - PMBOK Guide (Project Management Institute)



What is a WBS?

- A hierarchically-structured grouping of project elements:



- Defines total scope
- Deliverable-oriented
- Schematic
- Id-No. on each work package
- Can be used for each project phase

Why use WBS?

- **Advantages with a Work Breakdown Structure:**

- § Gives a common understanding of what to do
- § Improves the accuracy of cost, time, and resource estimations
- § Gives a baseline for performance measurement and control
- § Facilitates clear assignment of responsibilities

- **A good WBS makes it easier to keep control of the scope!**

- § Regular follow-up of WBS work packages
- § Checkpoint for limitations
- § Any changes of scope to be approved by the Client.
- § Use project change forms!



How to create a WBS (some tips)

- **Identification of work packages**

- § Engage people with various background and competence (include specialists).
- § Brainstorm on blank paper. For instance, use Post-it notes and pen.
- § Use experiences and lessons learned from similar projects.
- § Arrange the work packages in a strategic and schematic way.

- **Verification of scope**

- ü Summarise and discuss in the project team
- ü Use a reference group for review and further input
- ü Formal approval by the Client

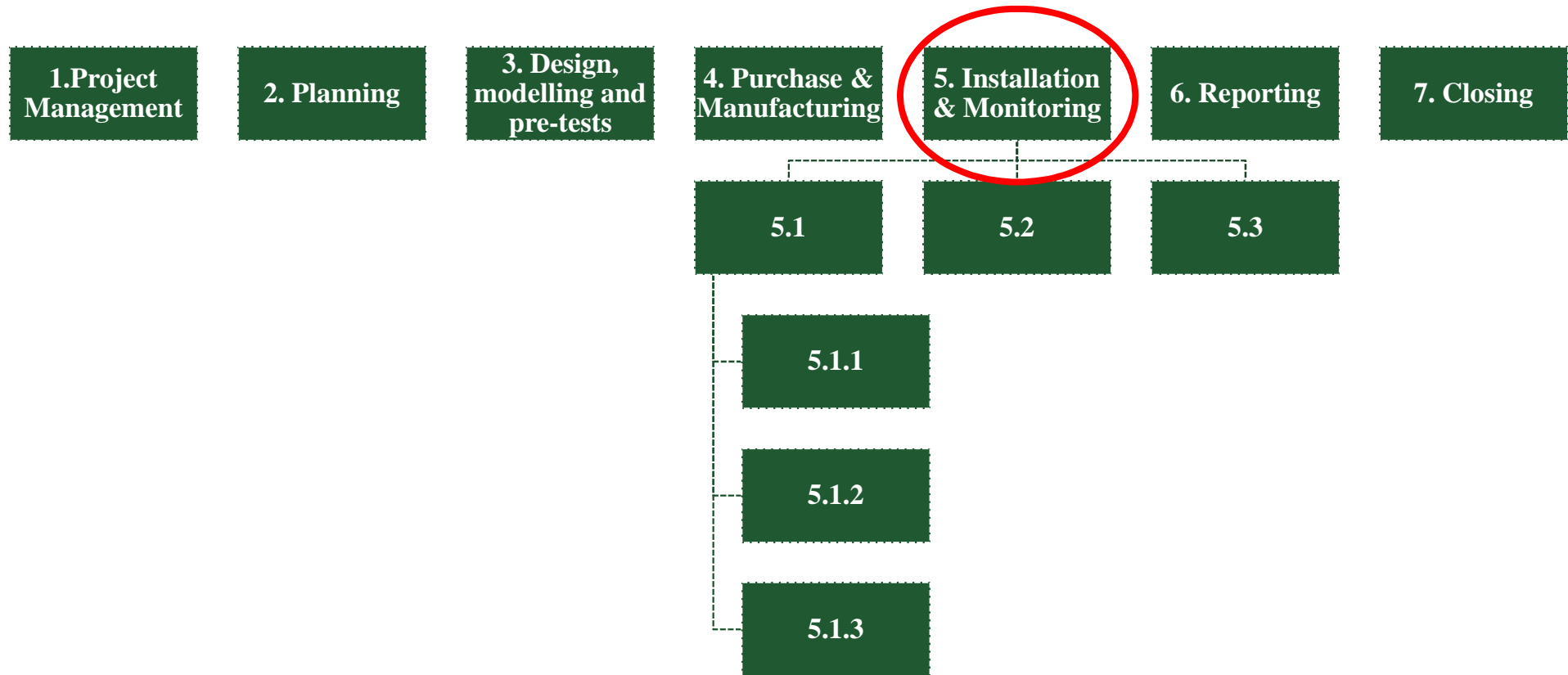


Group work - WBS

- Create a WBS for the DOMPLU full scale experiment
- Focus on the project phase Installation (including monitoring)
- Use information in the previous presentation (DOMPLU layout, and photos from installation)
- Ask experts (if necessary ;)



Group work – WBS



Presentation of group work



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Správa úložišť radioaktivních odpadů
Radioactive Waste Repository Authority



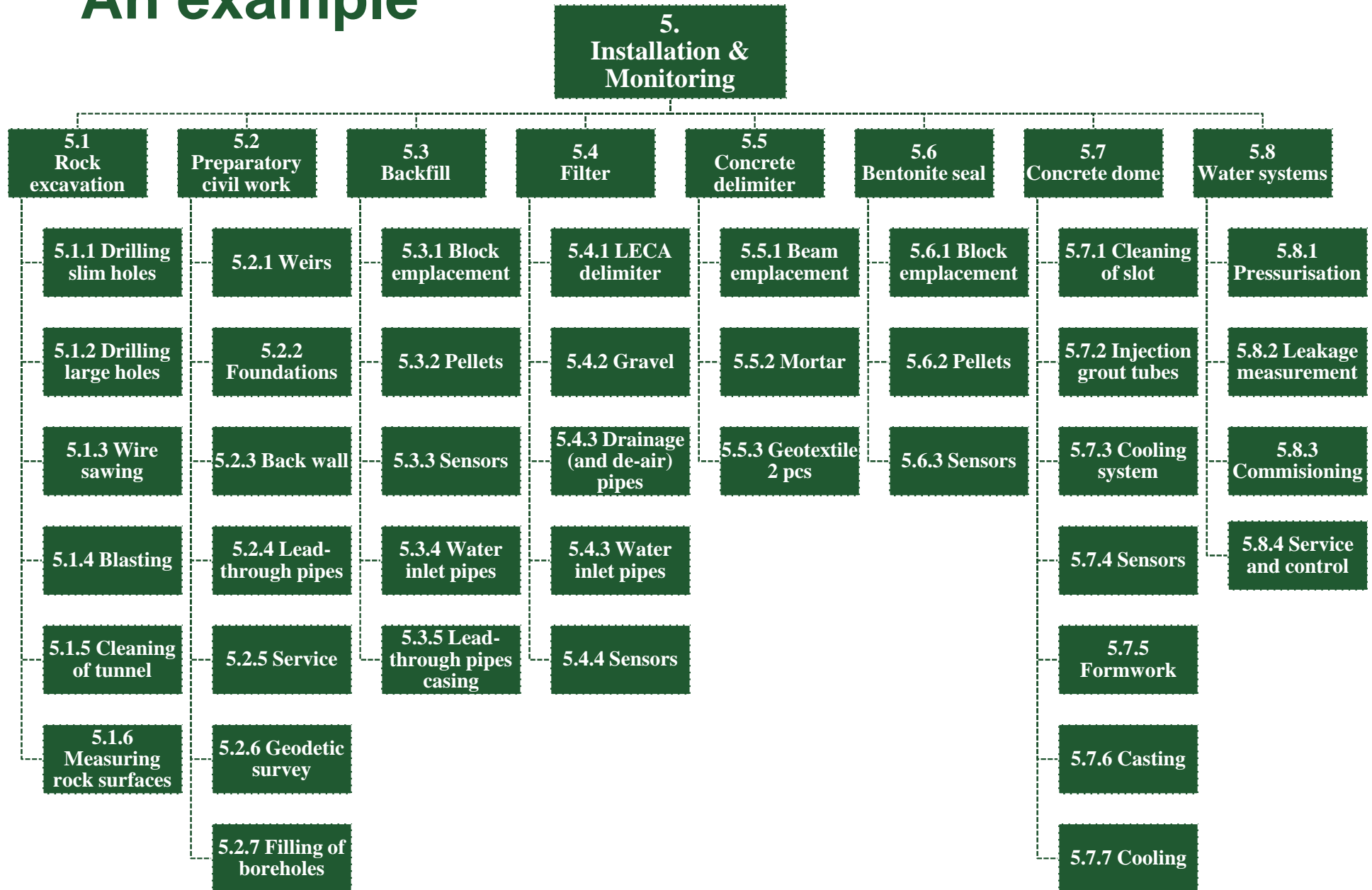
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An example





Thank you for a
great team work!

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