DOPAS
Training Workshop 2015

DOPAS

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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

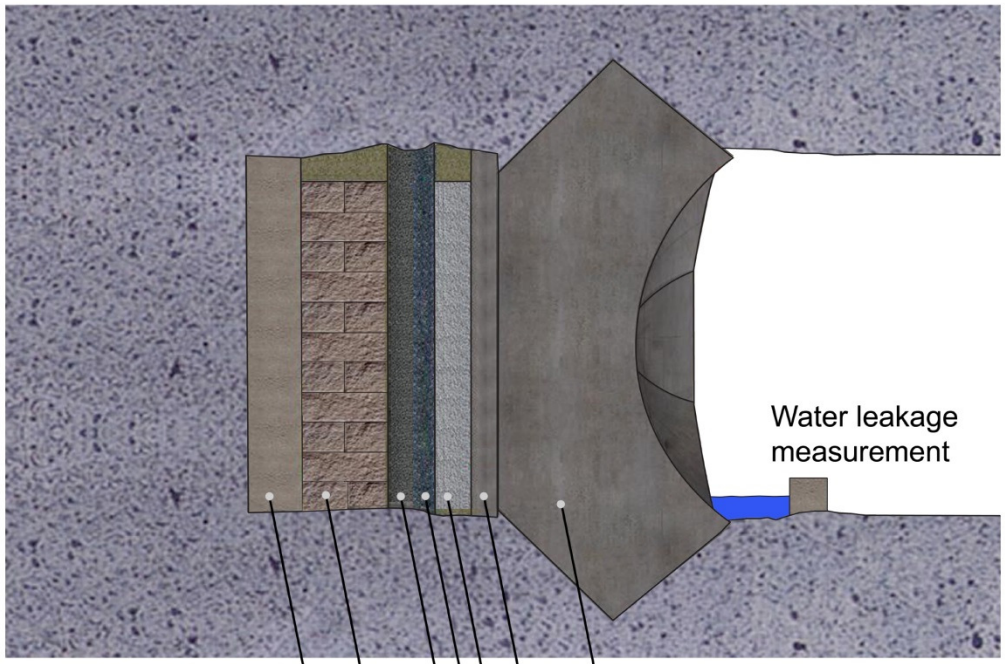
DOMPLU objectives (major)

- **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 <0.1 l/min 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



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

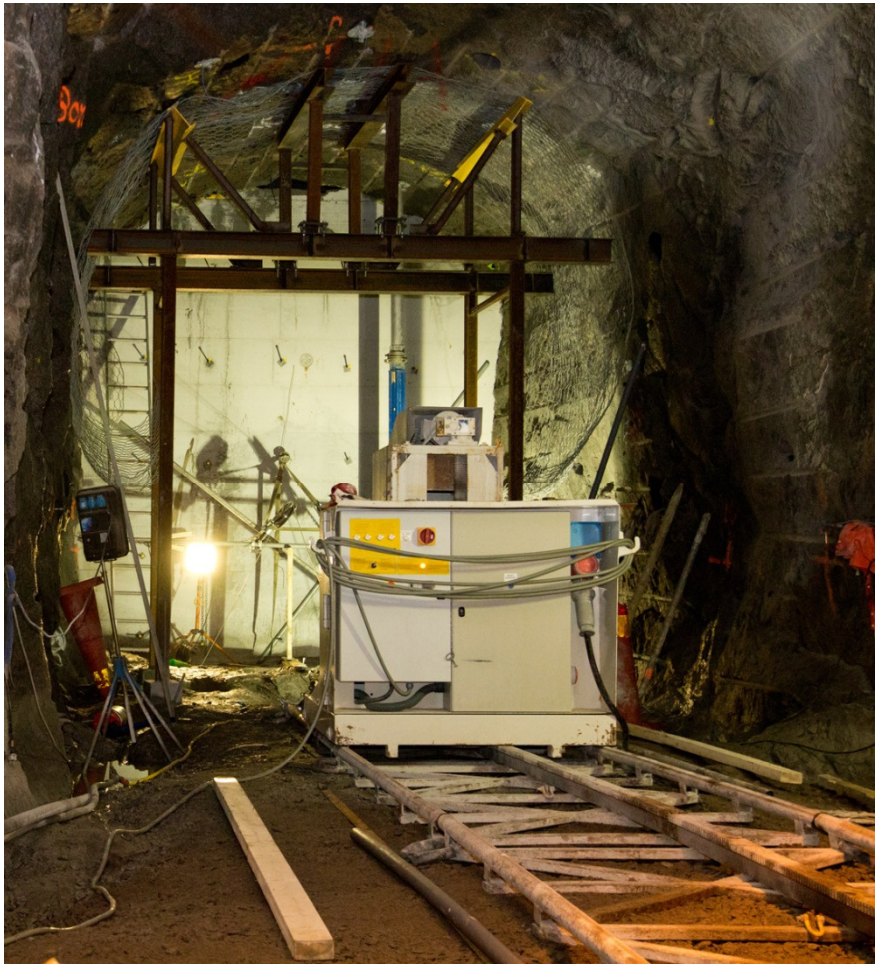
3 supplementary sensors in the lead-through pipe and the drainpipes
Pore pressures

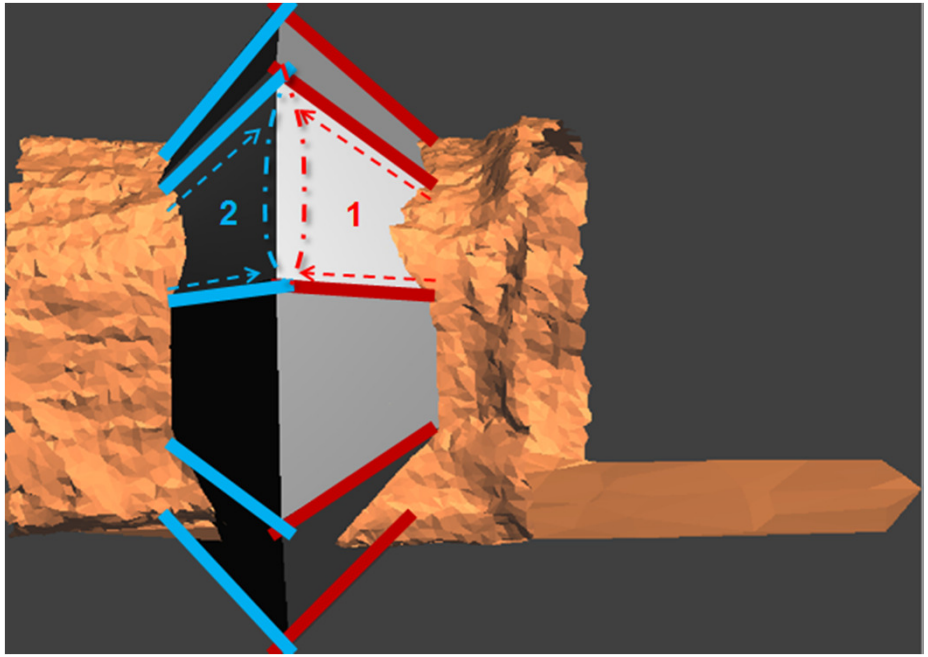
48 sensors in the bentonite seal, filter and backfill
Total and pore pressures, RH & temperatures, displacements.

- 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

Monitoring of leakage
On-line scale

Slot excavation by wire sawing





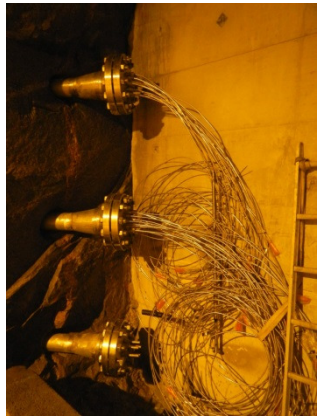
- **Symmetrical octagon design (16 cuts, ⌀ 8.8 m)**
- **Safety scaffold structure for workers protection**

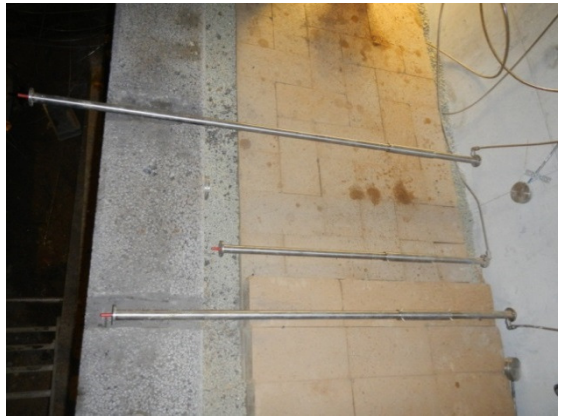
The excavated slot

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

- Model composed of laser scanning data

Installation 1 (3)





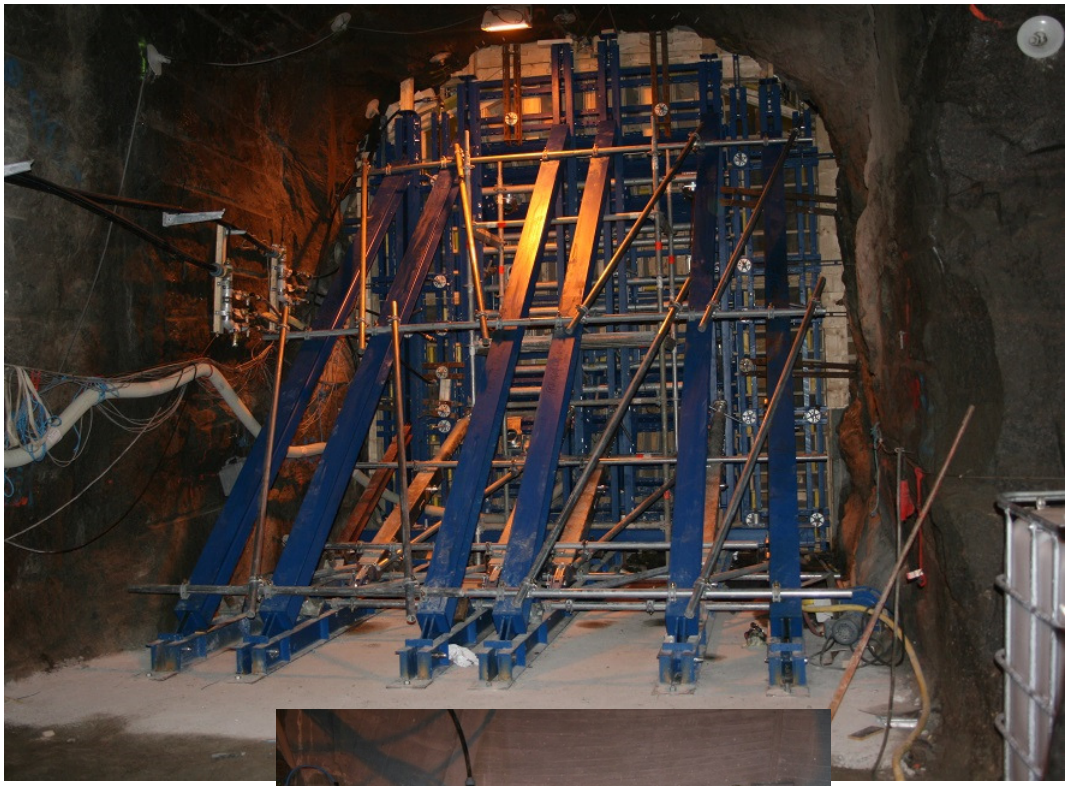
- **3 lead-through pipes for sensor cabling and water inlet pipes**
  - **Backfill blocks/pellets and LECA beams**
  - **Gravel filter, bentonite seal (MX-80 blocks/pellets) and concrete beams**

Installation 2 (3)

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

- **Concrete sensors**
- **Cooling system**

Installation 3 (3)



- **Formwork (by Doka)**
- **Casting (94 m^3 B200)**
  - **Non-reinforced structure**

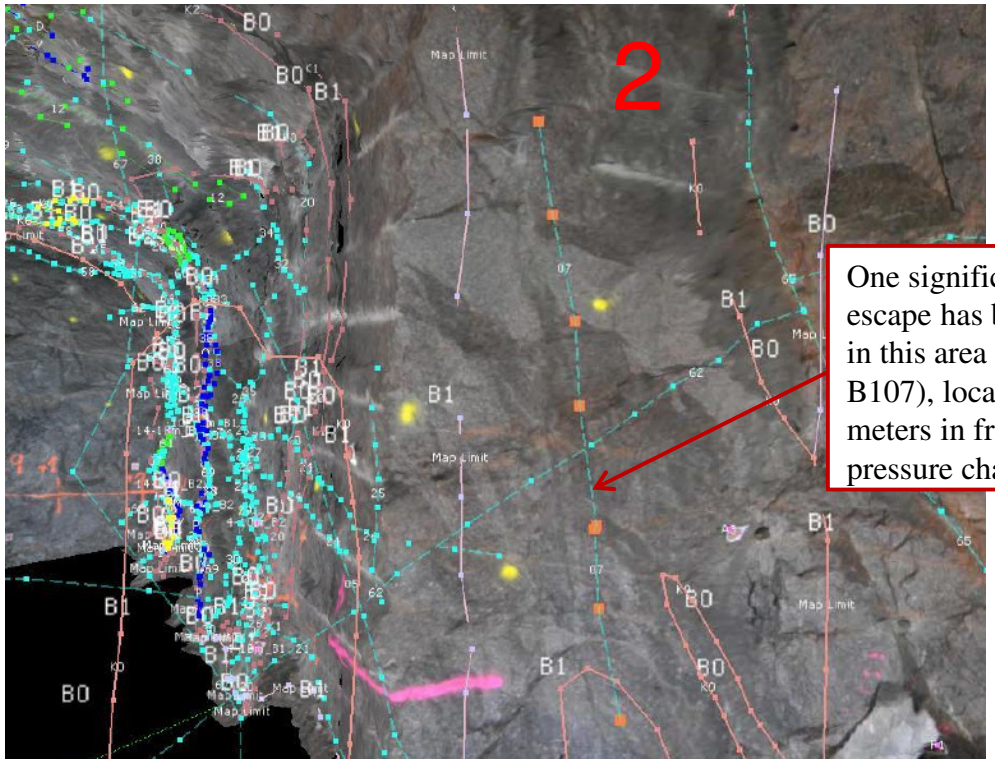
- **Chillers (redundant)**

DOMPLU in operation

- On-line leakage measurements.
- Plastic sheet reduces effects of tunnel ventilation and evaporation.

- 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.

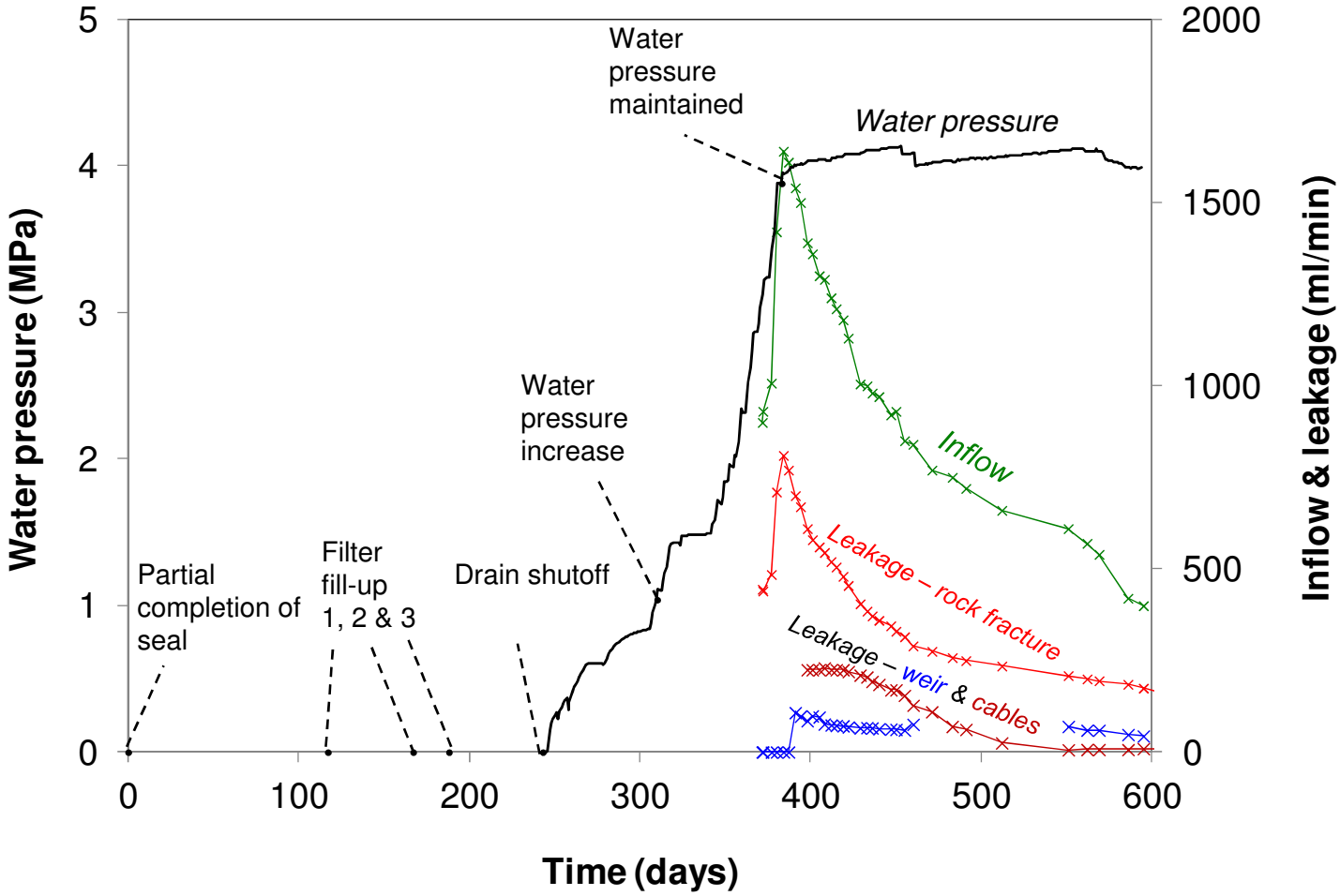
Water escapes



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.**

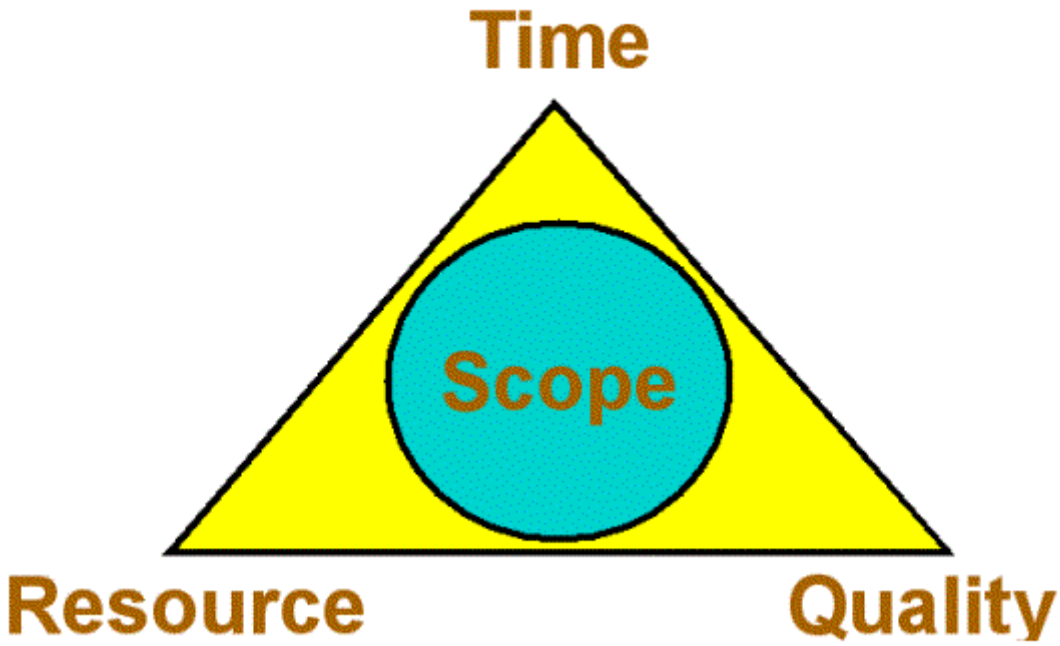
DOMPLU coming work

- **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). ***

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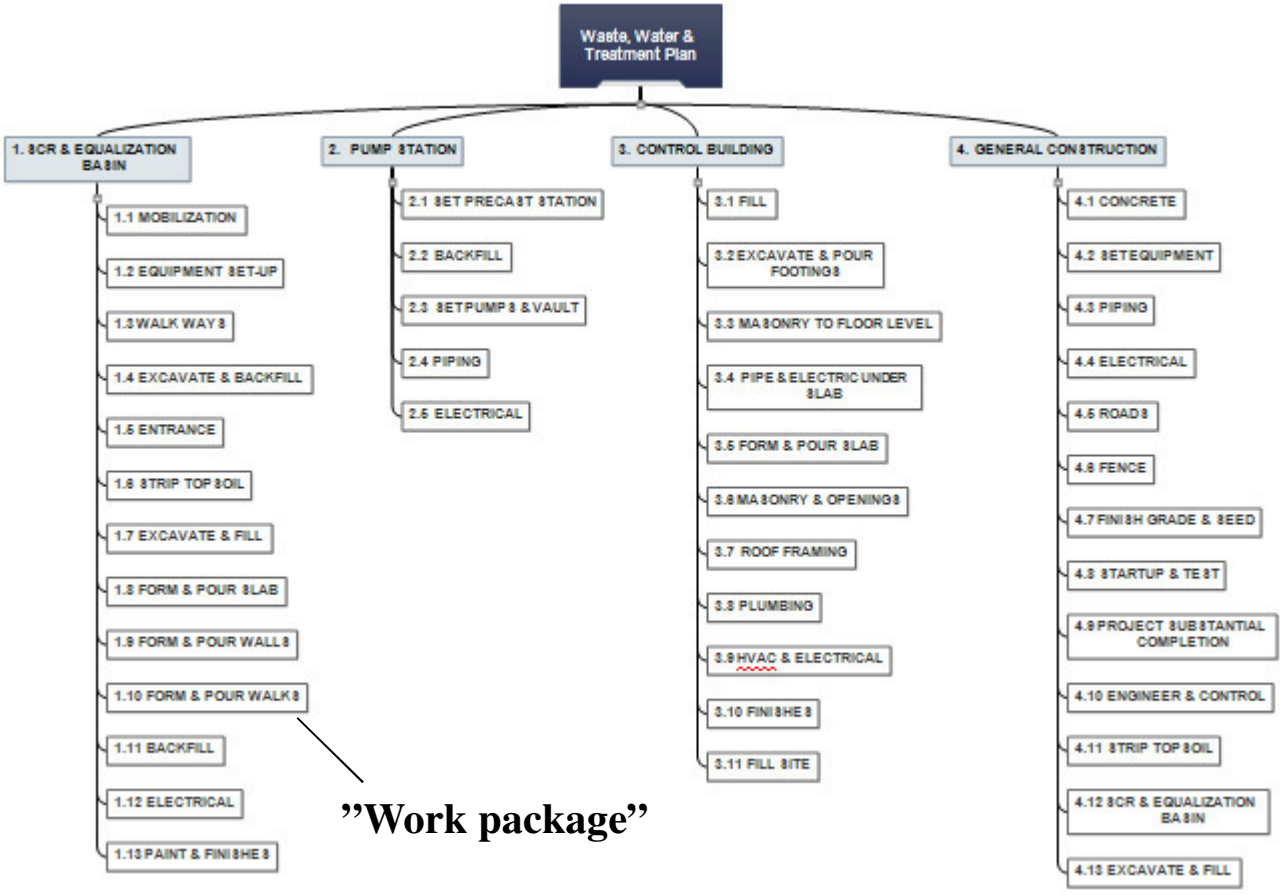
- ISO 21500 Guidance on project management
- ISO 10006 Guideline to Quality in project management
- PMBOK Guide (Project Management Institute)

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)

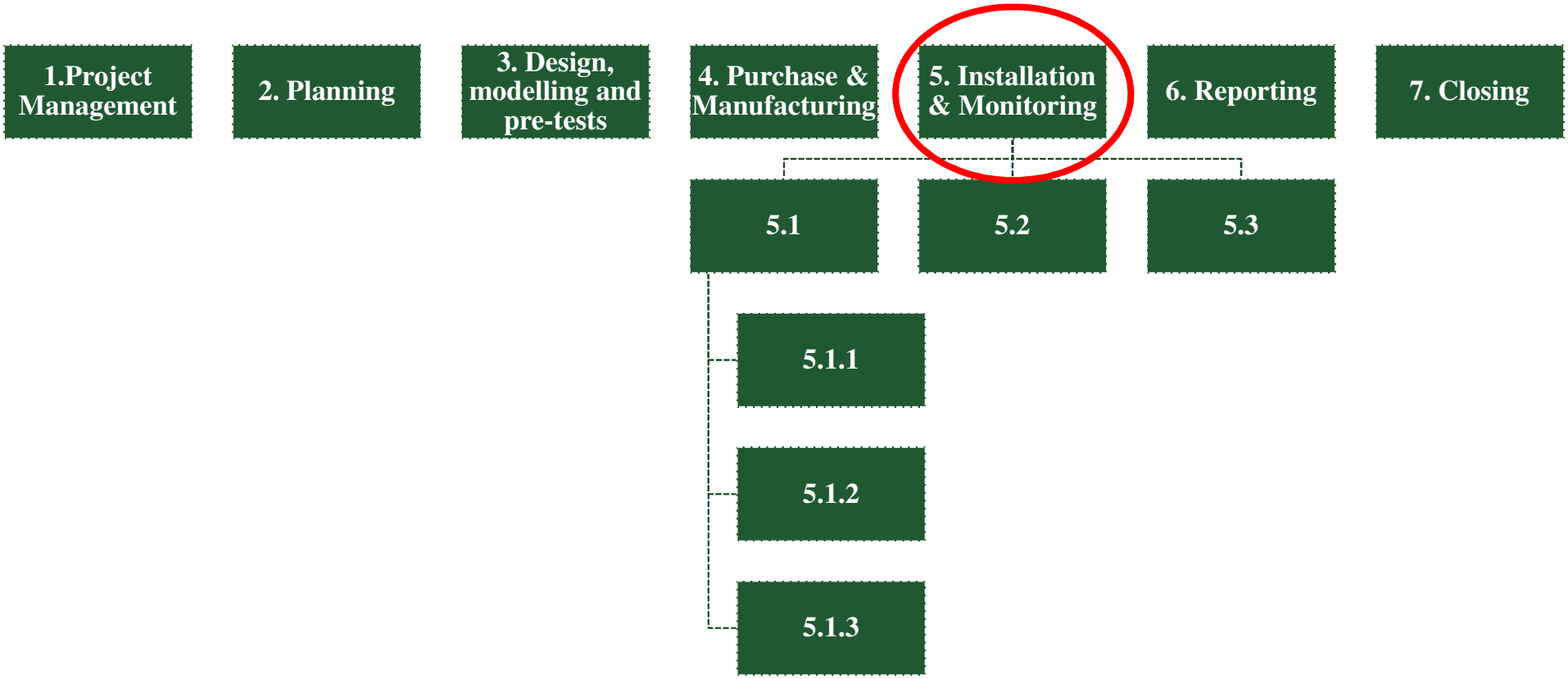
- **Identification of work packages**
  - Engage people with various background and competence (include specialists).
  - Brainstorm on blank paper. For instance, use Post-it notes and pen.
  - Use experiences and lessons learned from similar projects.
  - Arrange the work packages in a strategic and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

- **Verification of scope**
  - ✓ Summarise and discuss in the project team
  - ✓ Use a reference group for review and further input
  - ✓ Formal approval by the Client

Group work - WBS

- **Create a WBS for the DOMPLU full scale experiment**
- **Focus on the project phase <u>Installation</u> (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

DOPAS

Thank you for a great team work!

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