Canister retrieval status at SKB

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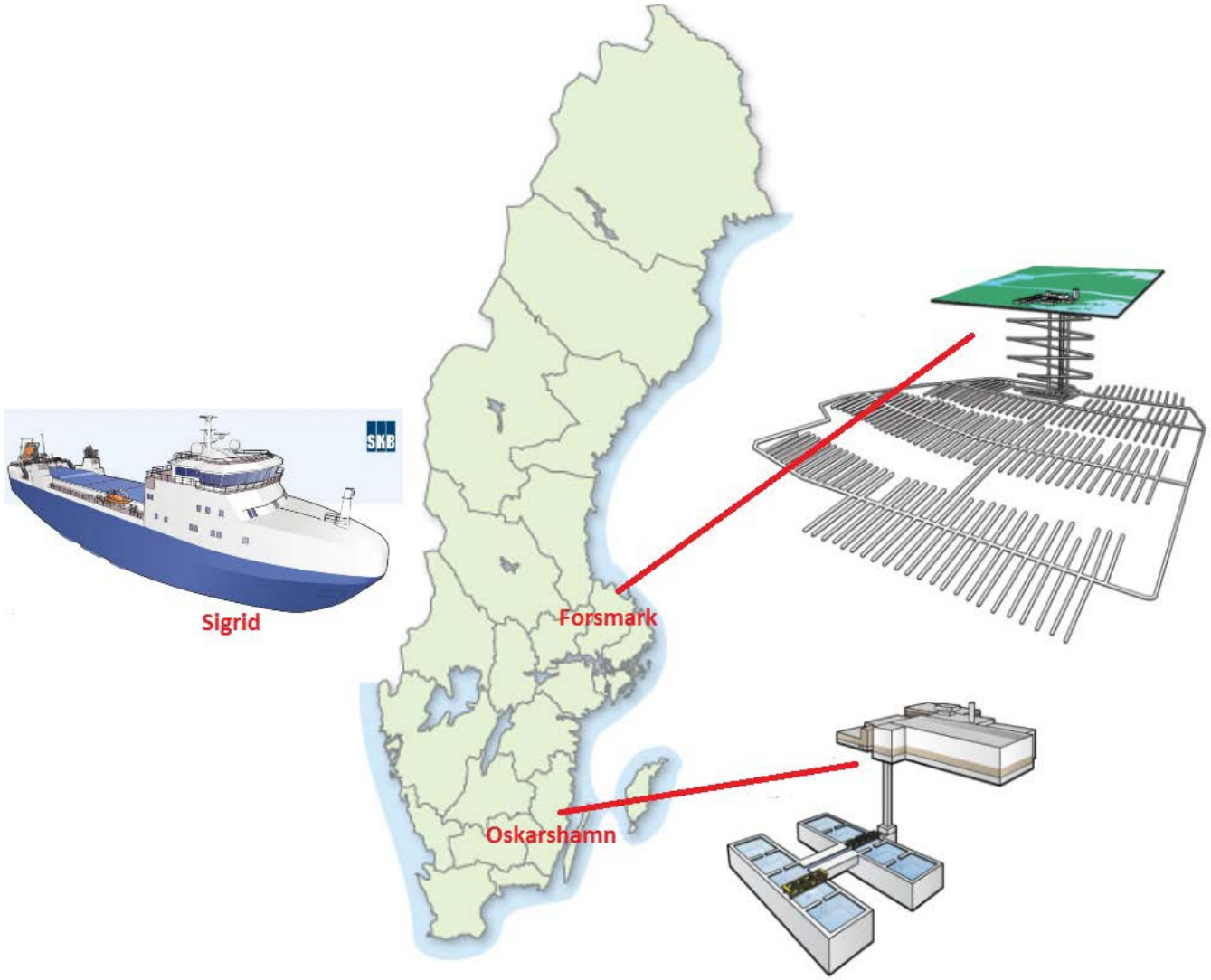
Definition of retrievability

- *Retrieval* is to bring the canister back from the deposition hole to the previous step in the handling process
- *Retrieval* takes place *before* the dismantling and closure of the repository

- **SSMFS 2008:37 The Swedish Radiation Safety Authority's Regulations Concerning the Protection of Human Health and the Environment in Connection with the Final Management of Spent Nuclear Fuel and Nuclear Waste**
- ***Intrusion and access***
- **Section 8** A repository shall be primarily designed with respect to its protective capability. If measures are adopted to facilitate access or to make intrusion more difficult, the effects on the protective capability of the repository shall be reported.

KBS-3 system



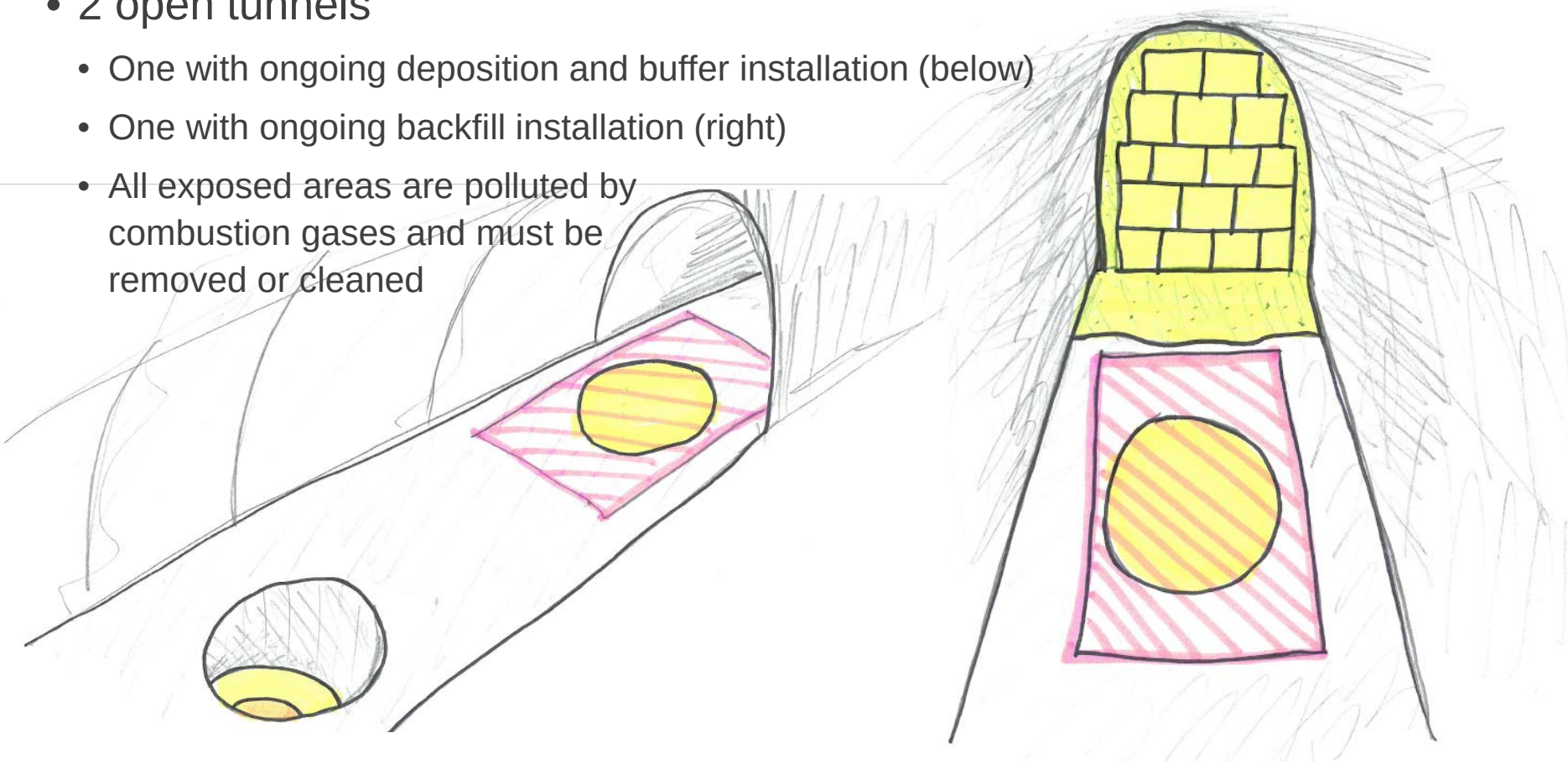
Start of work: Event analysis

- Methodology similar to deterministic safety analysis for NPPs:
- Which events cause the need to retrieve canisters from deposition holes *(Technical design requirements not fulfilled)*
- What are the probability of these events?
- What consequences (magnitude of retrieval activities) do these events result in?

- The event analysis has been used to decide
  - Which events SKB should be prepared for; and
  - To what extent the preparations should be made

Reference event: Underground fire

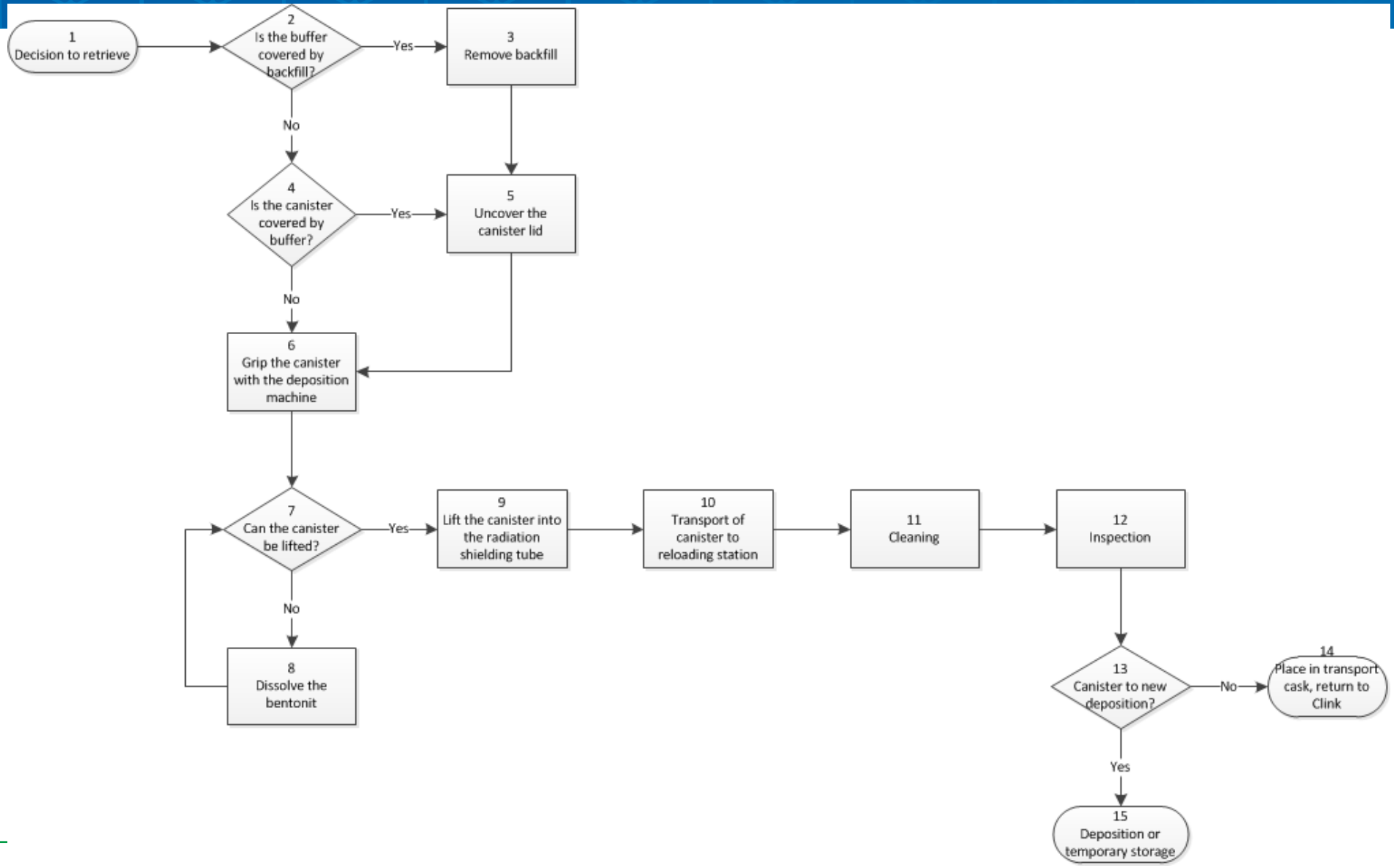
- 2 open tunnels
  - One with ongoing deposition and buffer installation (below)
  - One with ongoing backfill installation (right)
  - All exposed areas are polluted by combustion gases and must be removed or cleaned



Worst and best case

- The retrieval activities are so time consuming that the backfill takes up water, swells and loses density to below the technical design requirement.
- In that case, all backfill must be removed.
- It cannot be ruled out that the buffer and canisters underneath must be removed also.
- Best case: Only 1 or 2 canisters, buffer top blocks and the outermost layer of backfill must be removed.
- Worst case: Up to 40 canisters and large amounts (>10000 tons) of dry and wet bentonite must be retrieved

Generic retrieval process



Needs for methods

- Remove dry fragments of buffer blocks
- Remove intact, dry buffer blocks
- Remove wet buffer
- Lift canister
- Clean the canister from dry and wet bentonite and foreign substances
- Clean the deposition hole from dry and wet bentonite and foreign substances
- Inspect the canister
- Move and store canister(s) awaiting new deposition
- Transport the canister back to Clink for correcting measures
- Excavate dry backfill
- Excavate wet backfill
- Carry away excavated bentonite
- Cleaning rock surfaces from foreign substances: Fluids and soot

Methods to carry out the retrieval process

Excavate the backfill (3)

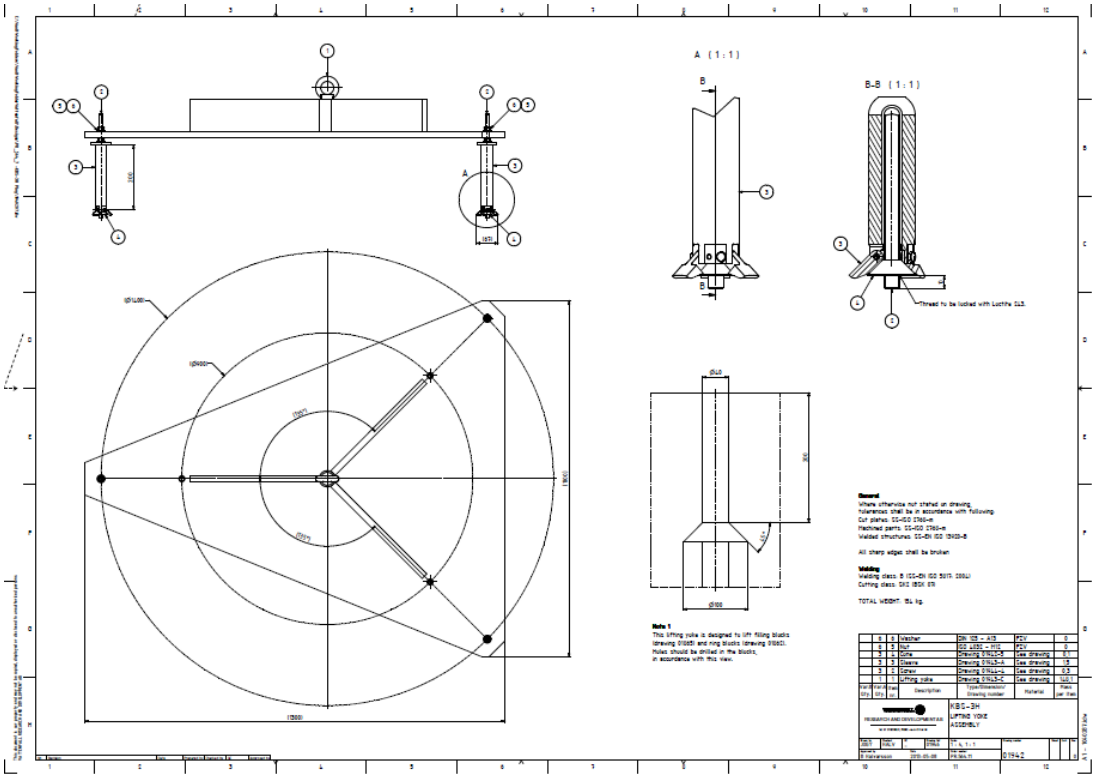
- Conventional front loader or excavator

Uncover the canister lid (5) – intact blocks, dry process

- Lift intact, dry buffer blocks

a.) Try the buffer handling tool (vacuum)

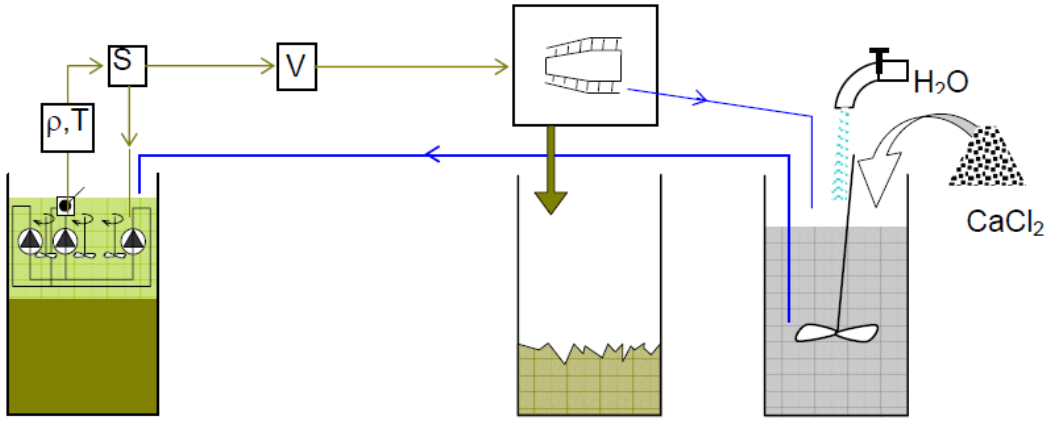
b.) Use a yoke for lifting in several positions (drilled holes in the block)



Uncover the canister lid (5), cont'd: -block fragments, dry process

- Large fragments: Vacuum lifting tool (right)
- Large fragments: Mechanical lifting tool (no yoke)
- Smaller fragments:Suction with large diameter hoses (normally used for sludge or similar).

Uncover the canister lid, wet process (8)



= pump

= blandare

= riktningsventil

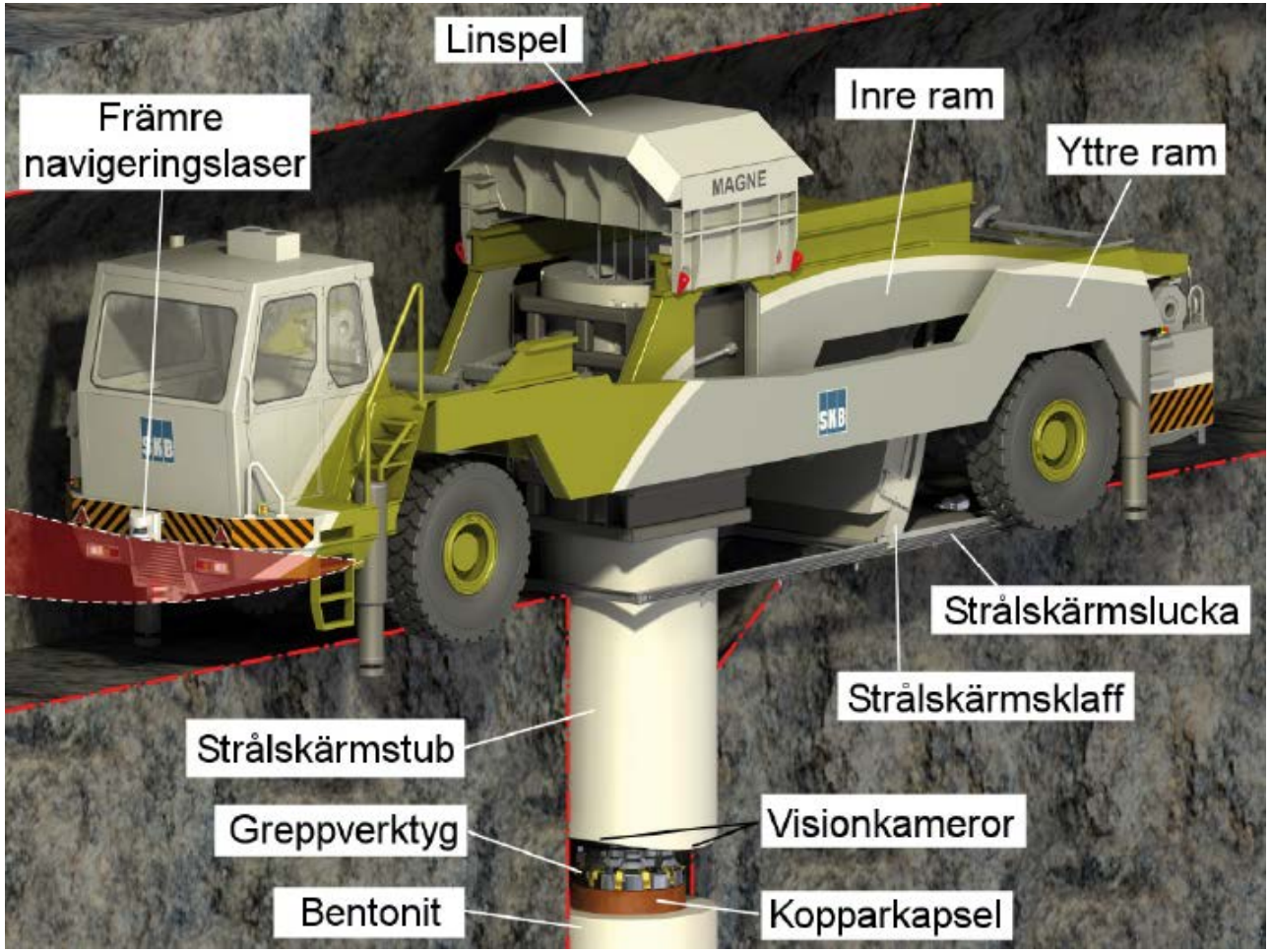
ρ, T = massflödes- och temperaturmätare

Sv = styrventil

V = volymflödesmätare

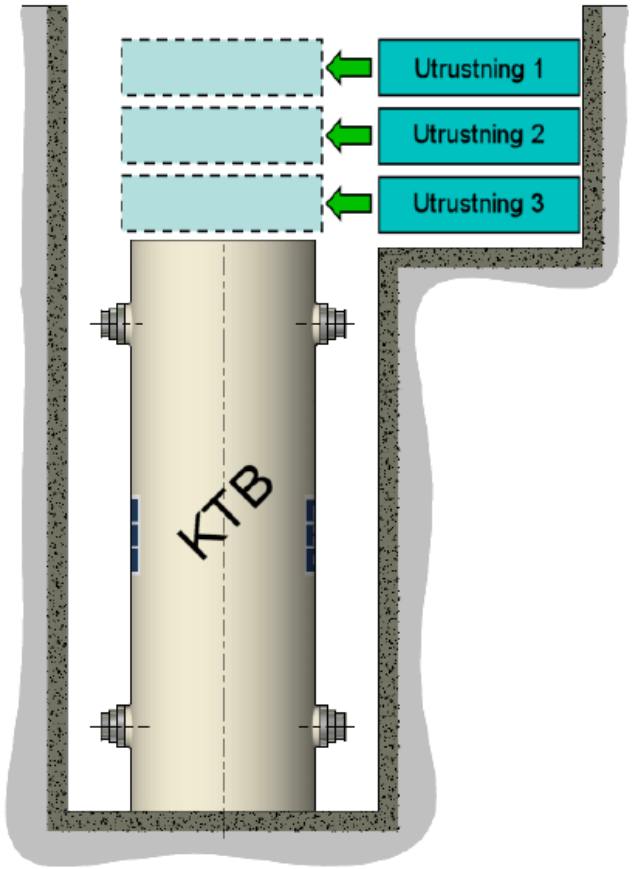
Griping and lifting the canister, transport to the reloading station

- The deposition machine is used for these actions

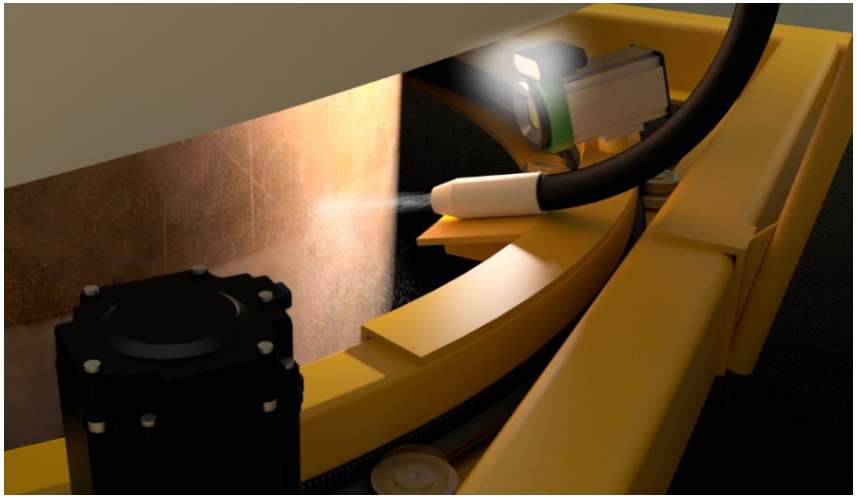


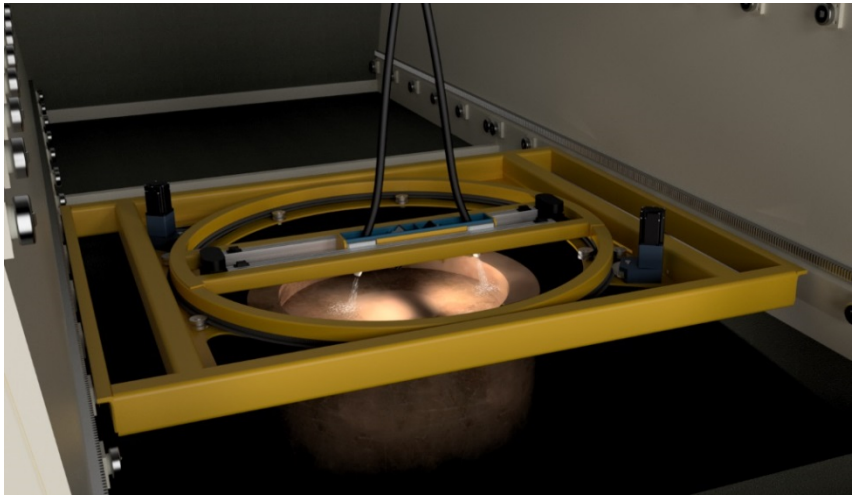
Cleaning and inspection (11,12)

- Tools are installed in a rack in a hotcell located under the reloading station (in the repository central area)
- The bare canister is placed on a pedestal



Cleaning – carbonic acid blasting





Inspection

- The surface is inspected by a remotely controlled laser scanning equipment.
- Laser based inspection can detect defects from tenths of millimeters – enough to find defects larger than accepted.
- If the surface is not sufficiently clean for the inspection, the blasting is repeated and a new attempt on inspection is made.

End of retrieval process at the repository

- The canister is approved – 3 alternative actions
  - The deposition machine transports the canister to a deposition hole and places the canister there.
  - The canister (if the retrieval concerns a single canister) is temporarily stored in one of the hotcells in the reloading station, on a pedestal or in a transport cask.
  - A canister can also be placed in a deposition tunnel prepared (pedestal, protection from dripping water) for temporary storage
- The canister is not approved
  - Return to the encapsulation facility in a transport cask
  - The canister is opened and the fuel is transferred to a new canister
  - The new canister is sent to the repository for renewed deposition and final storage

Next step

- Development of the retrieval methods that are not yet industrialised for the application
- Introduction of the commercial tools into the equipment planning system for the repository
- Investigations and decision concerning the operation of a retrieval, e.g.
  - The response time for the retrieval equipment
  - The number of positions for temporary storage that should be prepared
  - Etc.

Thank you!

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