



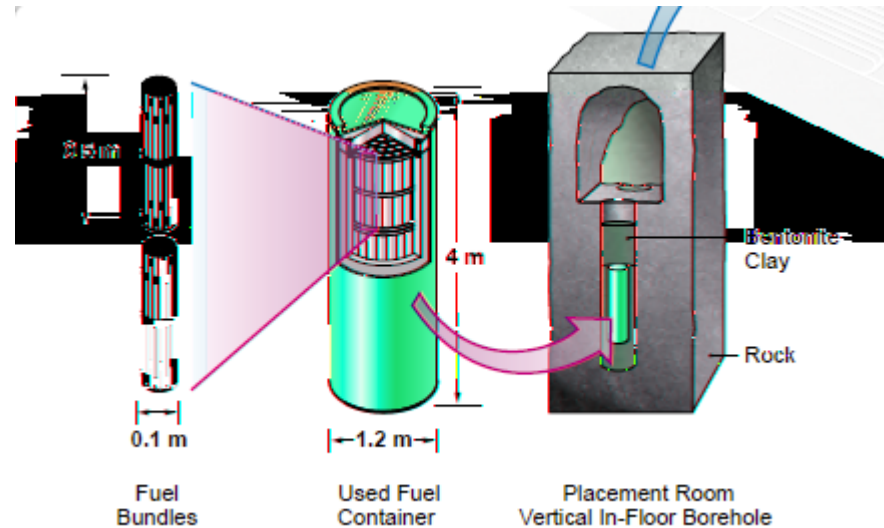
APM Project Description

Presented by: Derek Wilson
April 05, 2016

2011 Reference NWMO Conceptual Designs

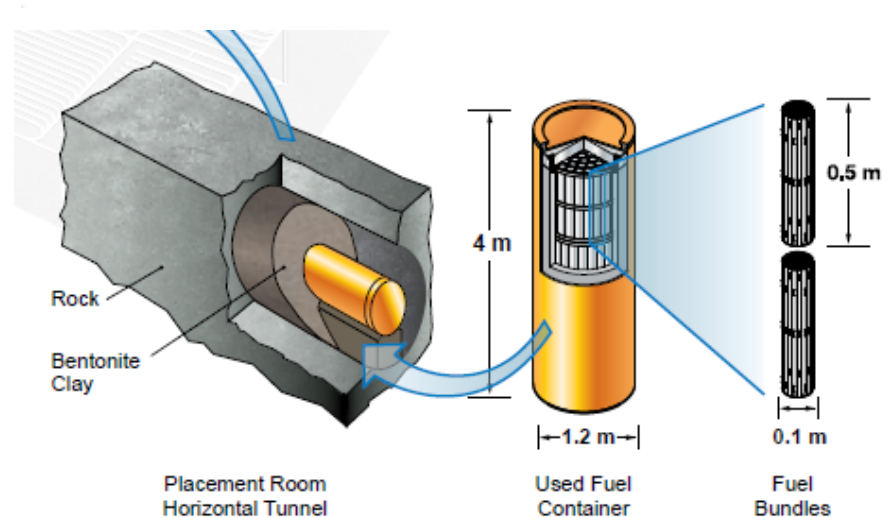
4th Safety Case

- SKB (Sweden)
- Crystalline rock
- In-floor bore hole
- Dual vessel (steel/copper)



5th Safety Case

- NAGRA (Switzerland)
- Sedimentary rock
- Horizontal tunnel in-room
- Steel or dual vessels



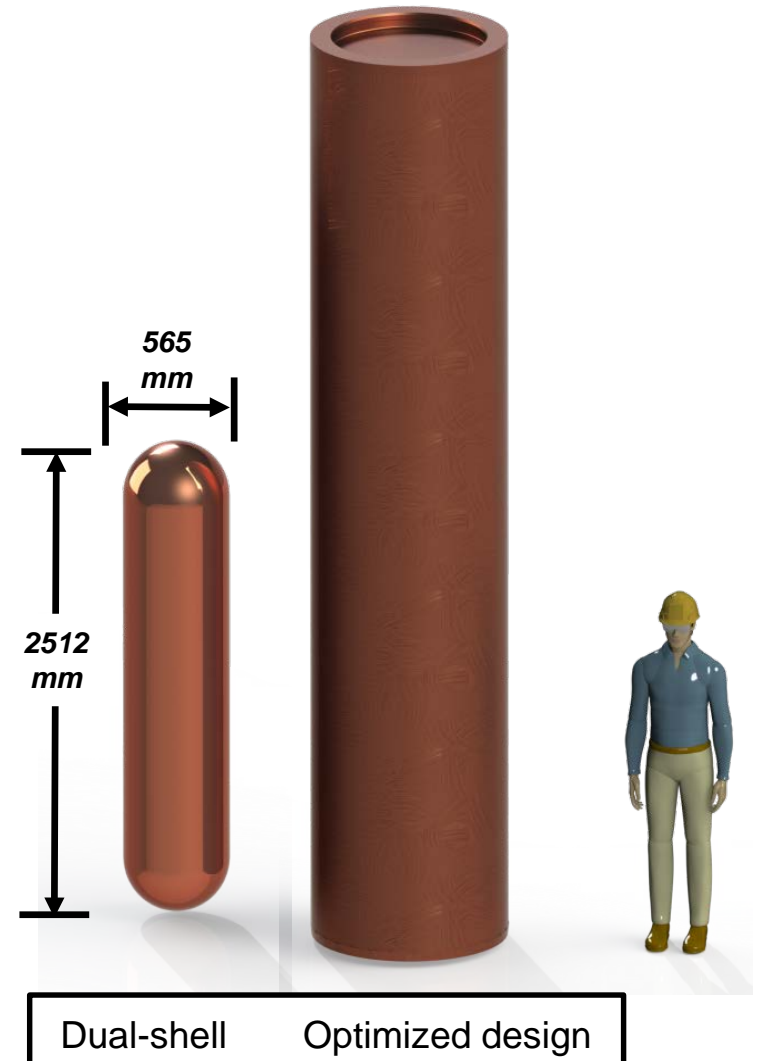
Container Design Review & Optimization

Dual-shell design

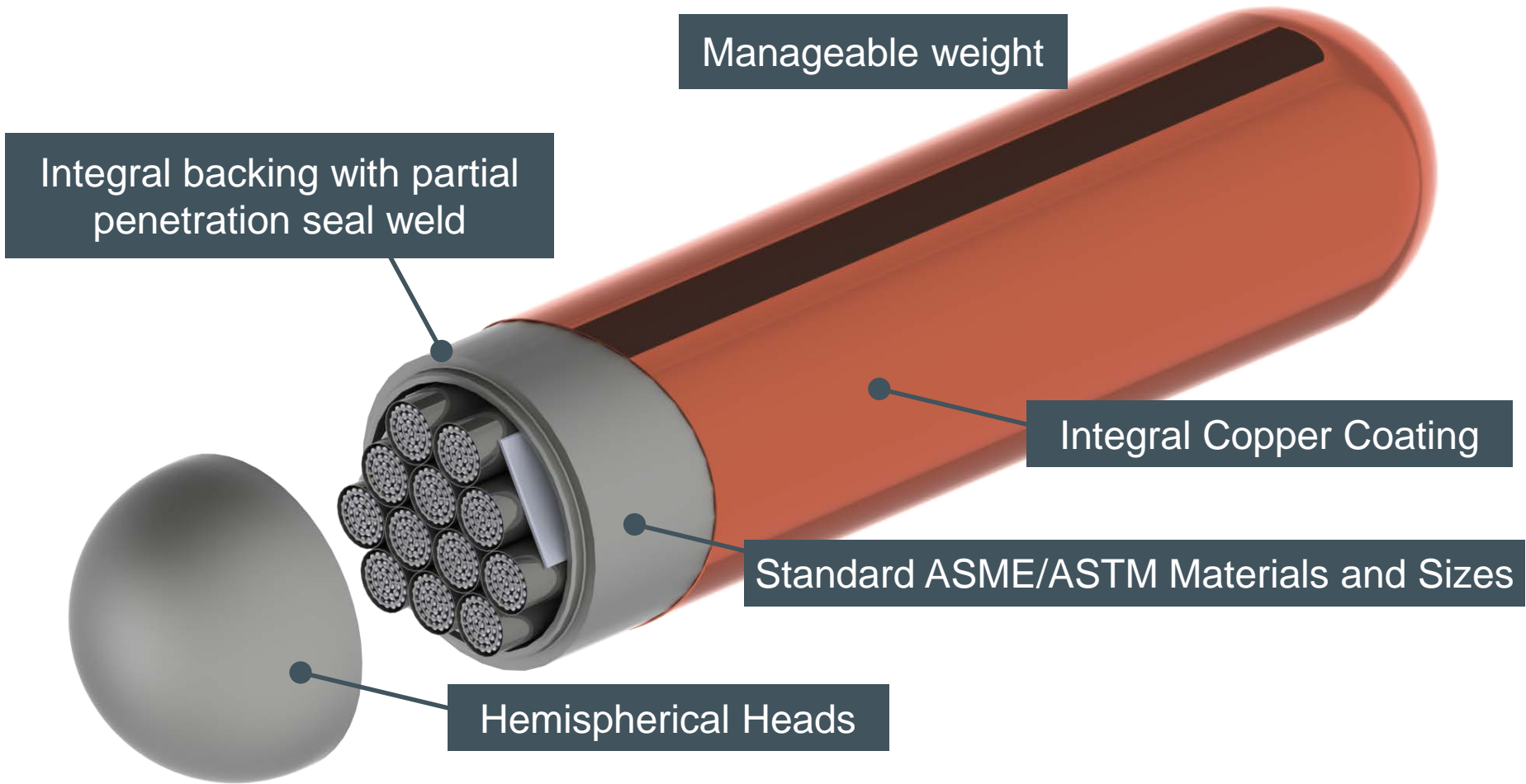
- Copy the KBS-3 concept as much as possible to be able to take advantage of SKB's learning curve
- No development ongoing

Optimized design for CANDU fuel

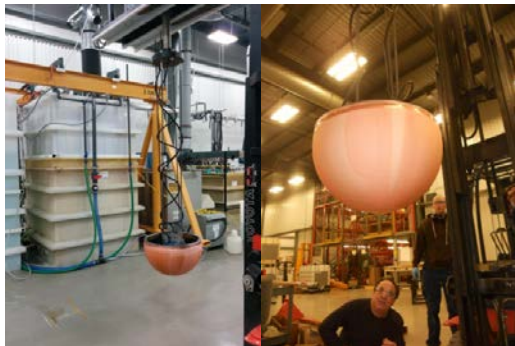
- Design alternatives related to size and geometry
- Apply advances in copper coating technology to apply required thickness of corrosion barrier



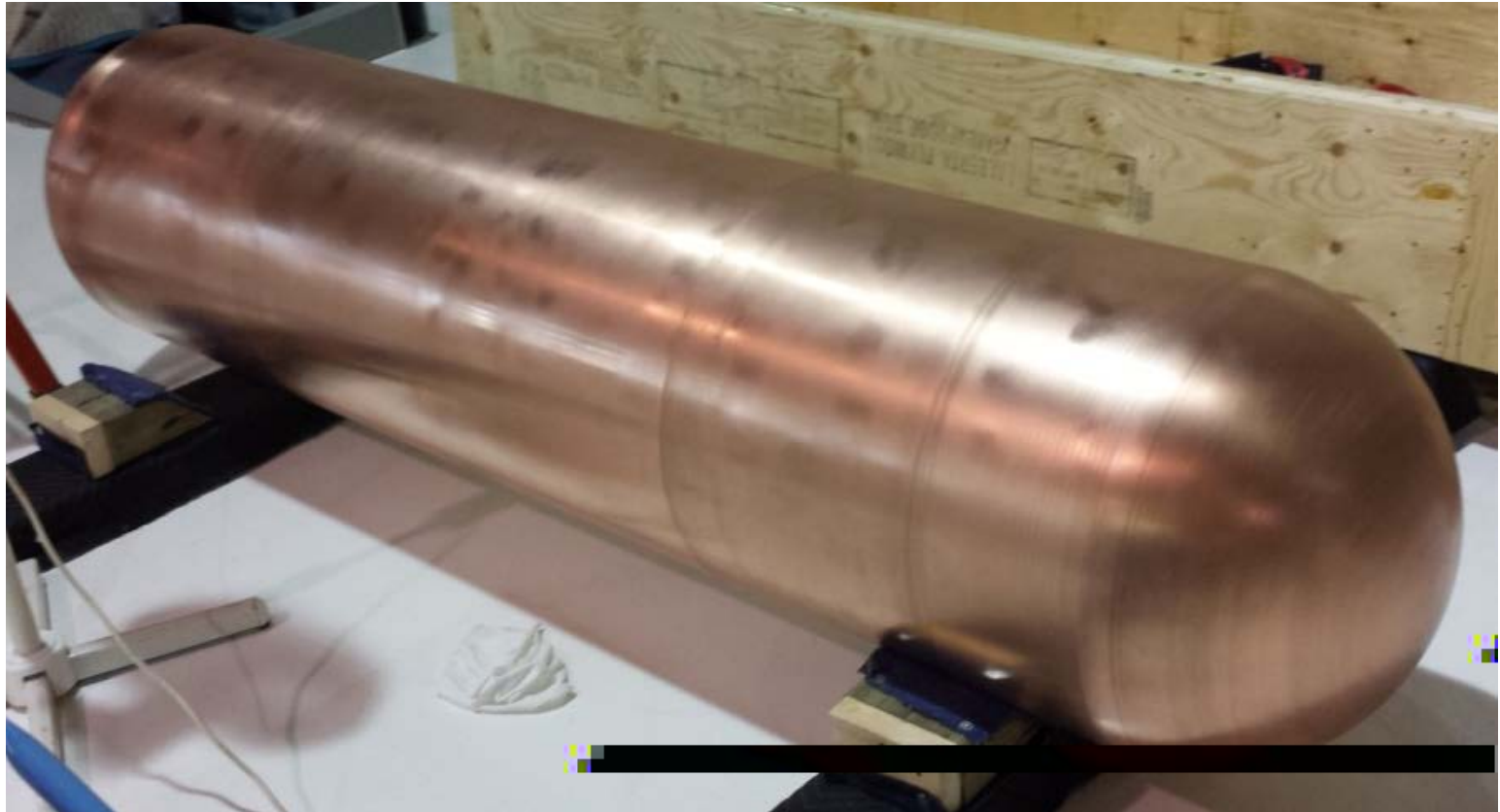
Container Design Features



UFC Manufacturing Processes

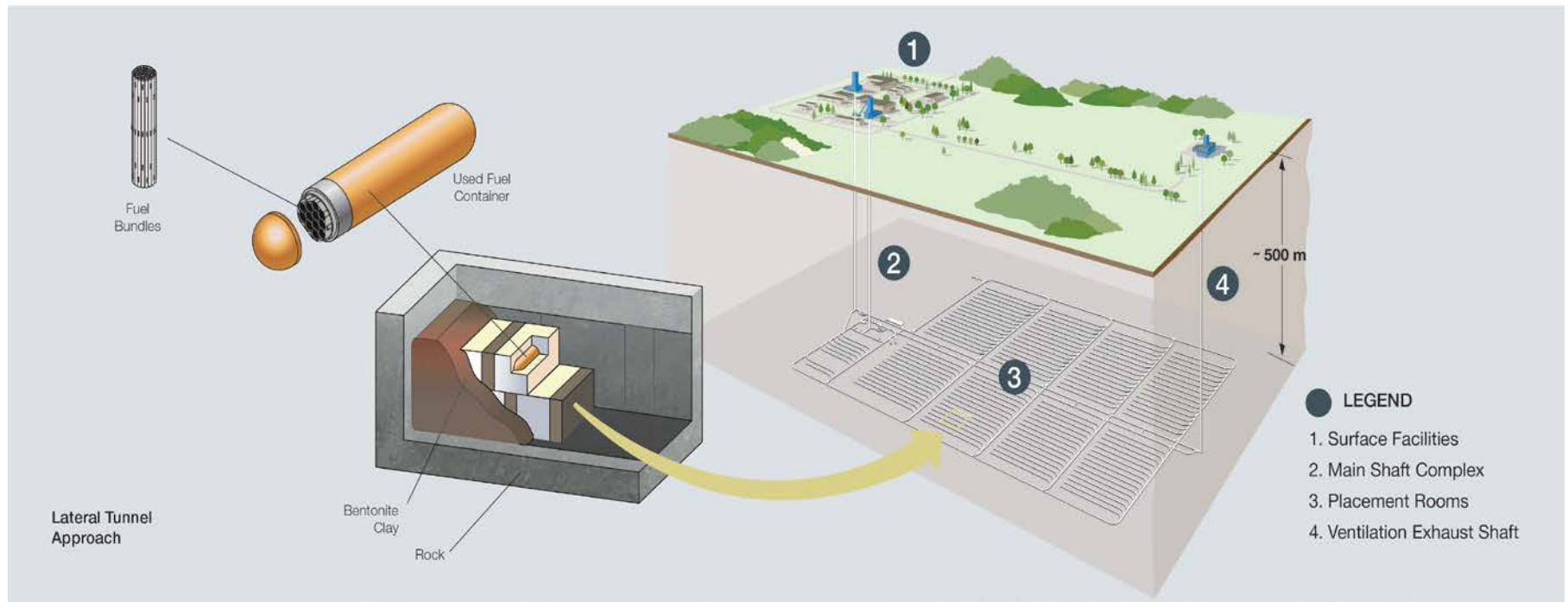


First Container Prototype



APM - Deep geological repository

- Multi-barrier system to safely contain and isolate used fuel over the long term
- Based on modern technology (copper coating & laser welding) and optimized for CANDU fuel



Centre of Expertise

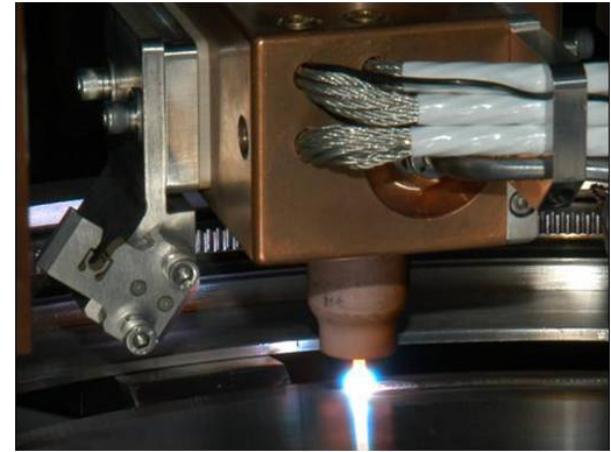


Centre of Expertise - Technical Function

- Provide an opportunity to demonstrate the processes developed as part of the proof testing program:
 - Used fuel container cells (laser welding, copper coating)
 - Used fuel handling equipment
 - Bentonite and buffer production and placement
 - Emplacement equipment and processes
- Support the detailed site characterization efforts (core storage and logging, materials laboratory, etc.)
- Environmental monitoring and laboratory
- Maintenance facilities and sample storage
- Needs could expand into the construction phase

Closure Weld - HLAW

- » Closure weld technology assessment complete
- » Completed feasibility and optimization stages
- » Considered factory versus in-process requirements
- » NDE requirements and technology
- » Progressed to full size mock-ups



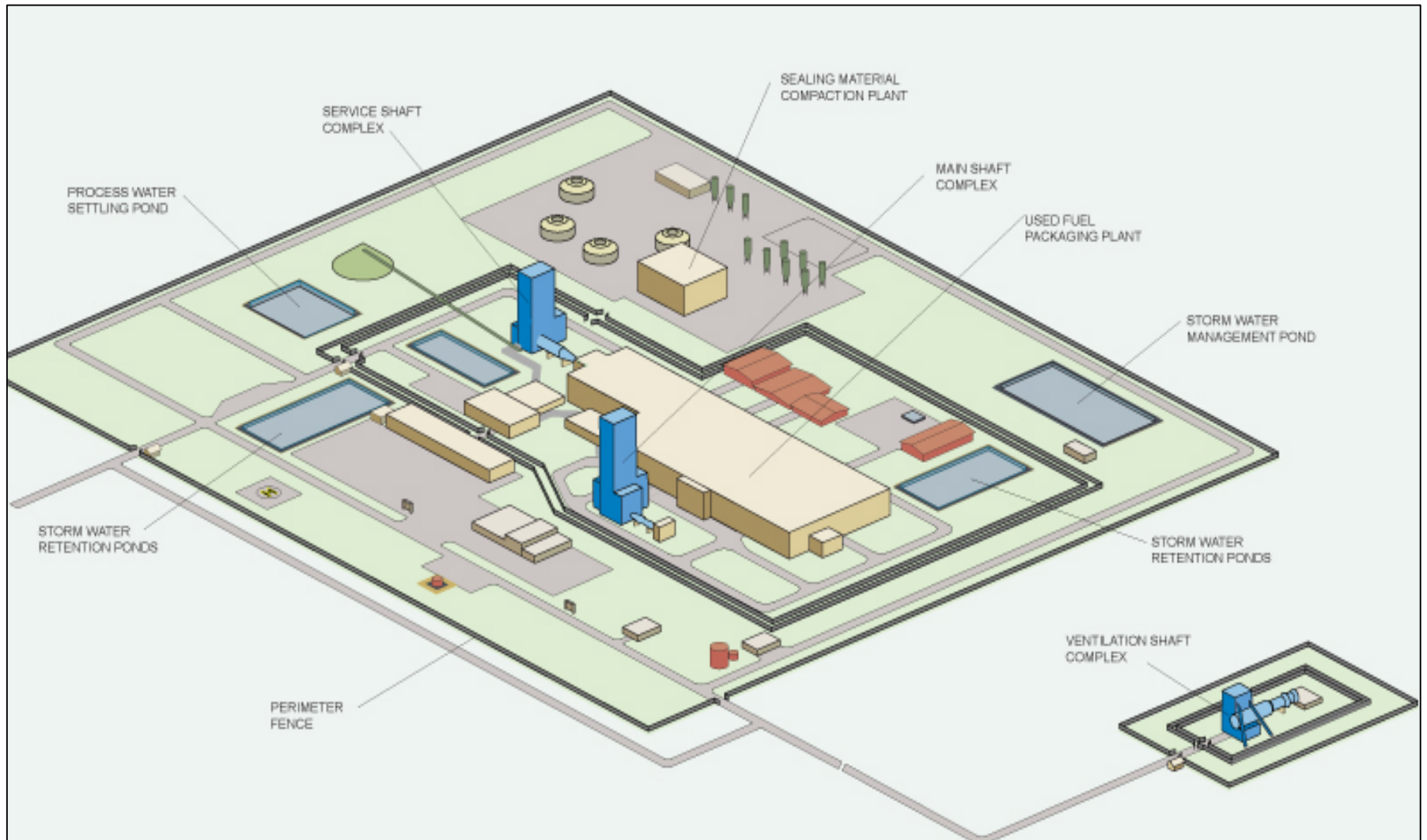
Cold Spray Copper Coating



Electro-deposition Copper Coating



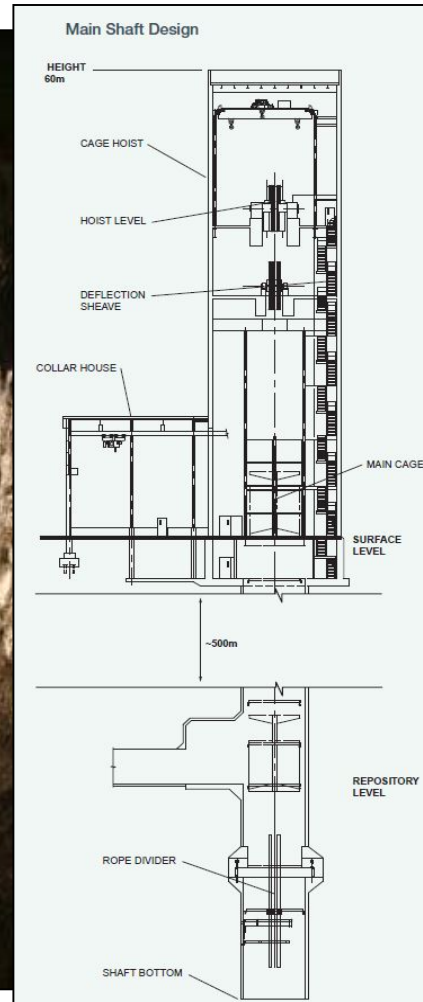
Conceptual Site Layout



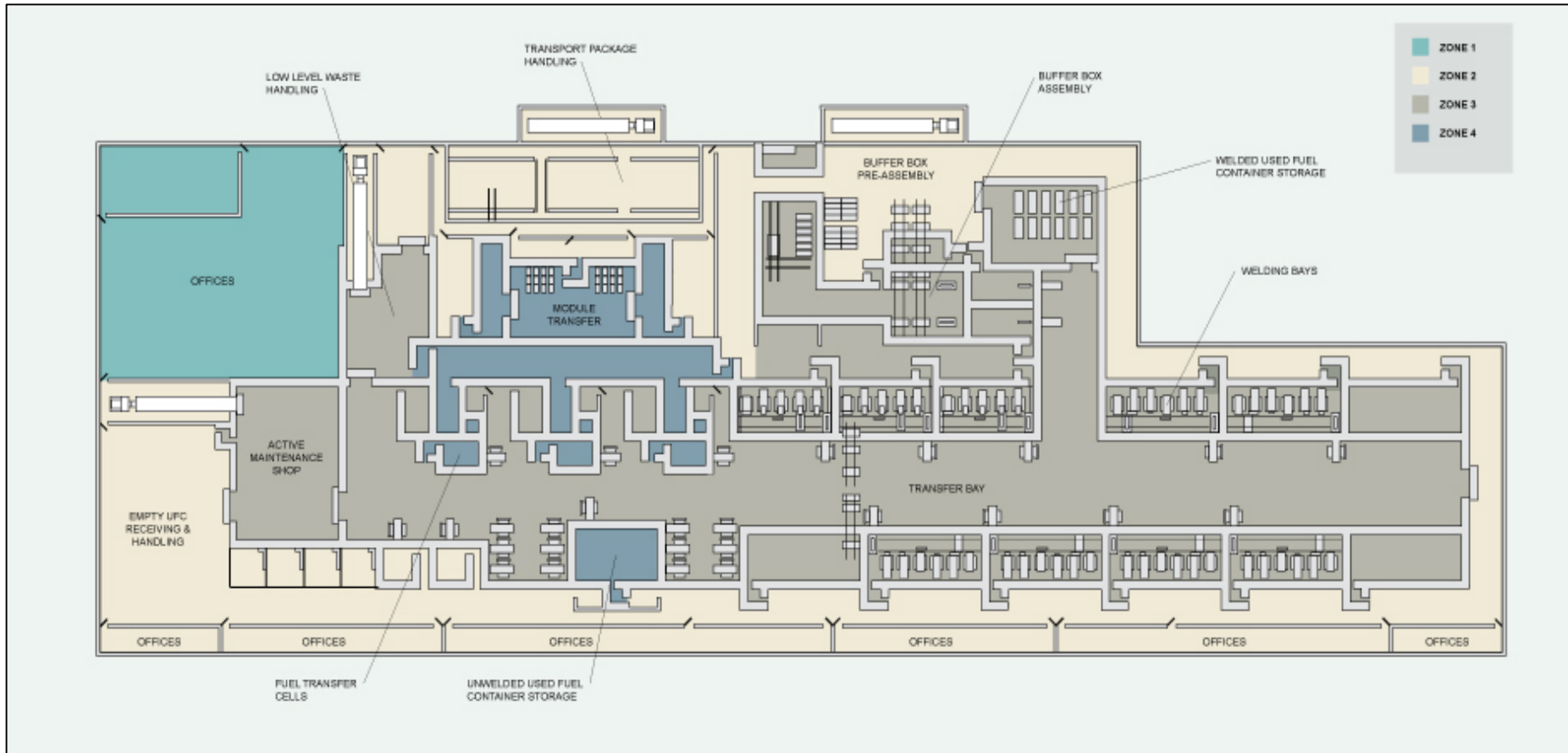
Key Surface Facilities

- Access and ventilation shafts
 - Main shaft – used fuel container transport
 - Service shaft – transport personnel, equipment, waste rock
 - Ventilation shaft – primary exhaust air pathway
- Used Fuel Packaging Plant (UFPP)
- Sealing Materials Compaction Plant (SMCP)
- Process and surface water management systems
- Administration and auxiliary services facilities
- Security and safety services (first aid and fire services)
- Laboratory and radiation protection facilities

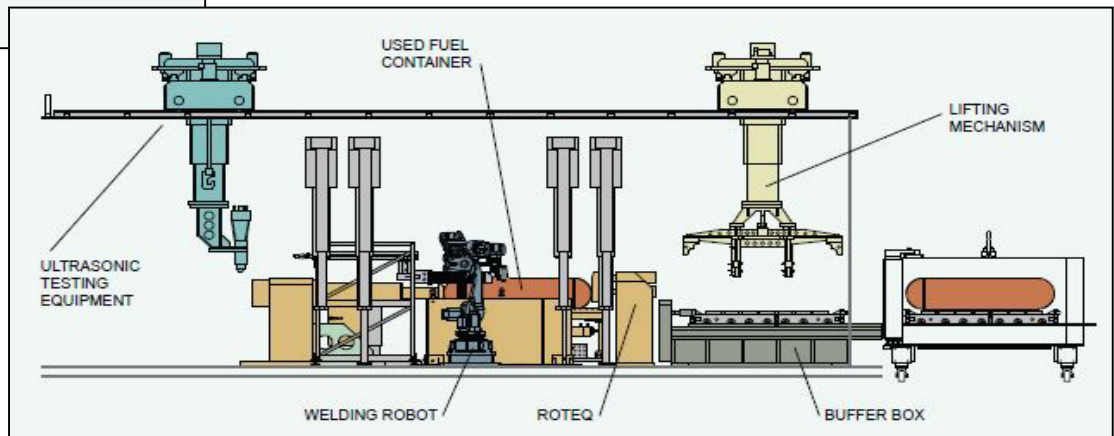
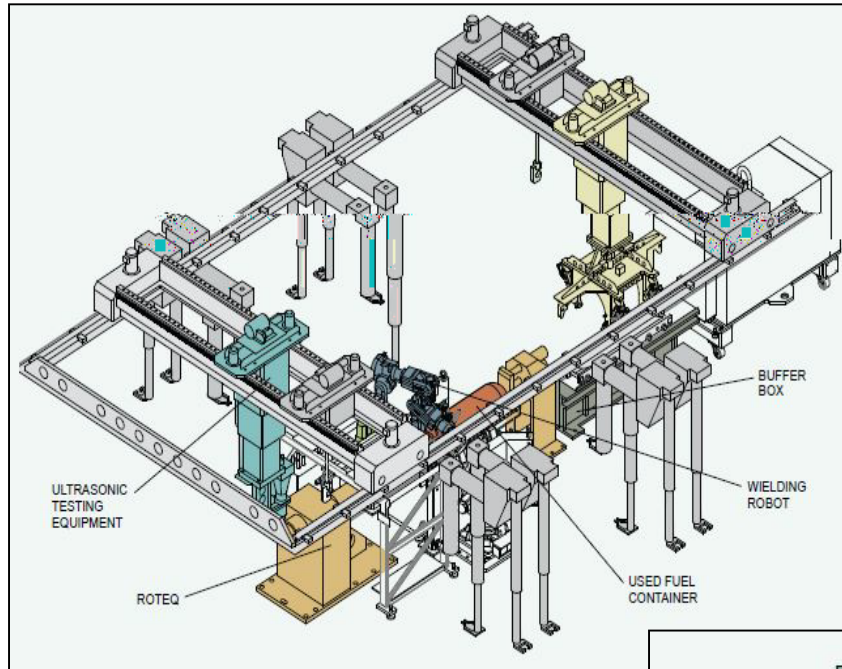
Access and Ventilation Shafts



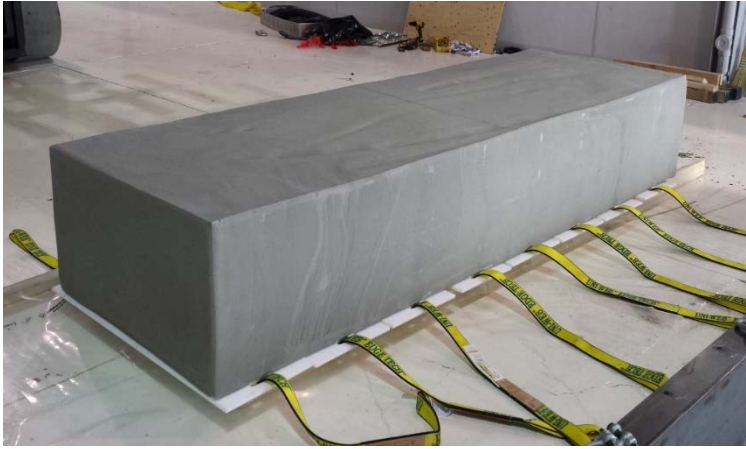
Used Fuel Packaging Plant



Used Fuel Packaging Plant – Cont'd



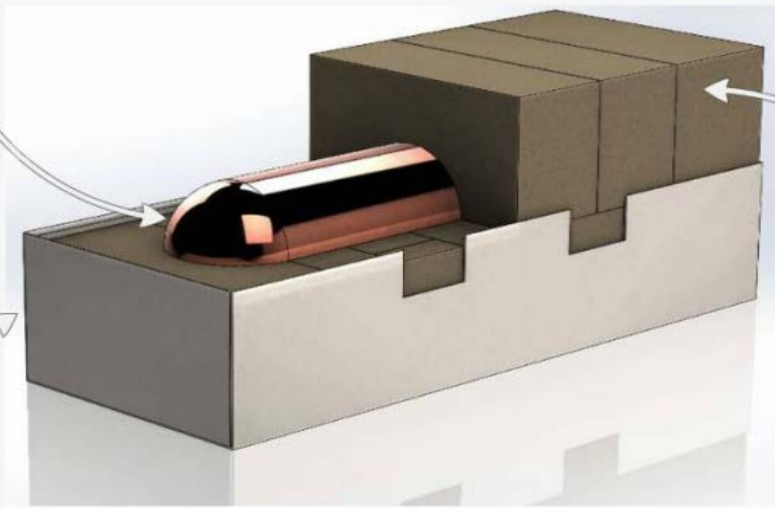
Sealing Materials Compaction Plant



Buffer Box



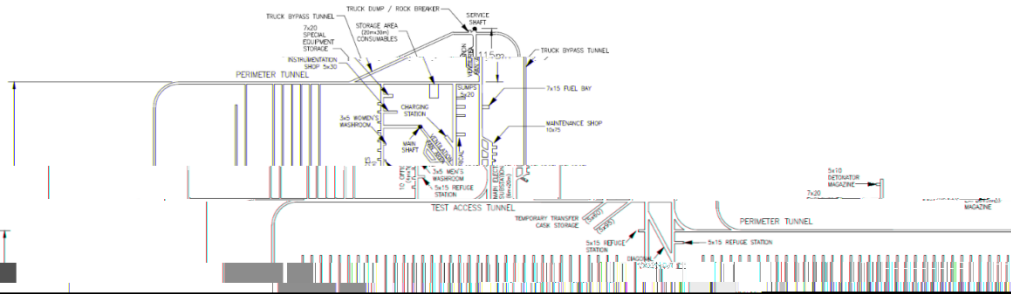
Used fuel container



Buffer box shell

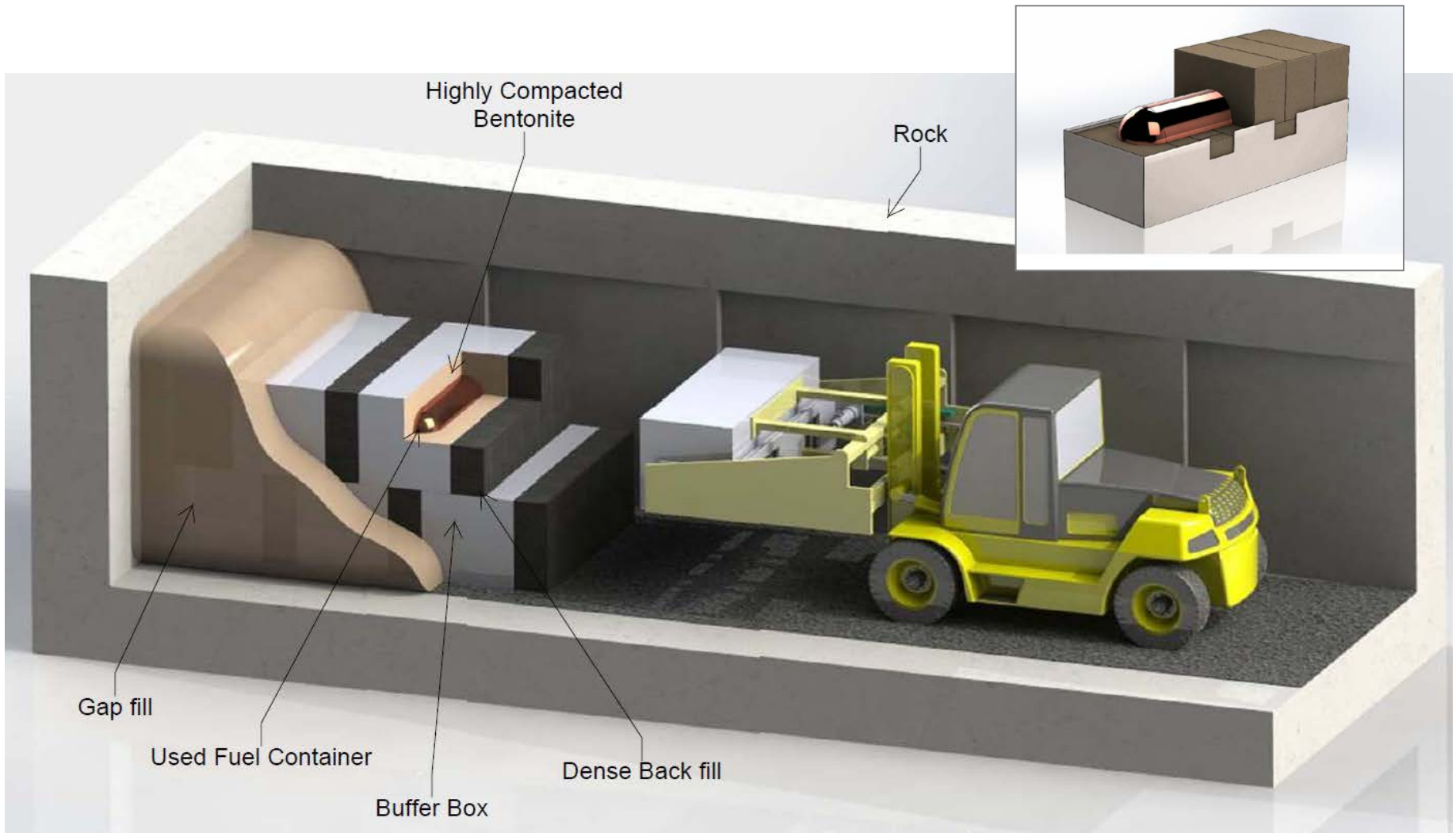
Bentonite blocks

Conceptual Repository Layout



- Capacity for 4.6 M bundles (reference is 3.6M bundles)
- Sedimentary host rock at depth of ~ 500m
- Underground footprint is ~340 Ha
- Operations for 40 years followed by 70 yrs of monitoring
- Concurrent construction and operations

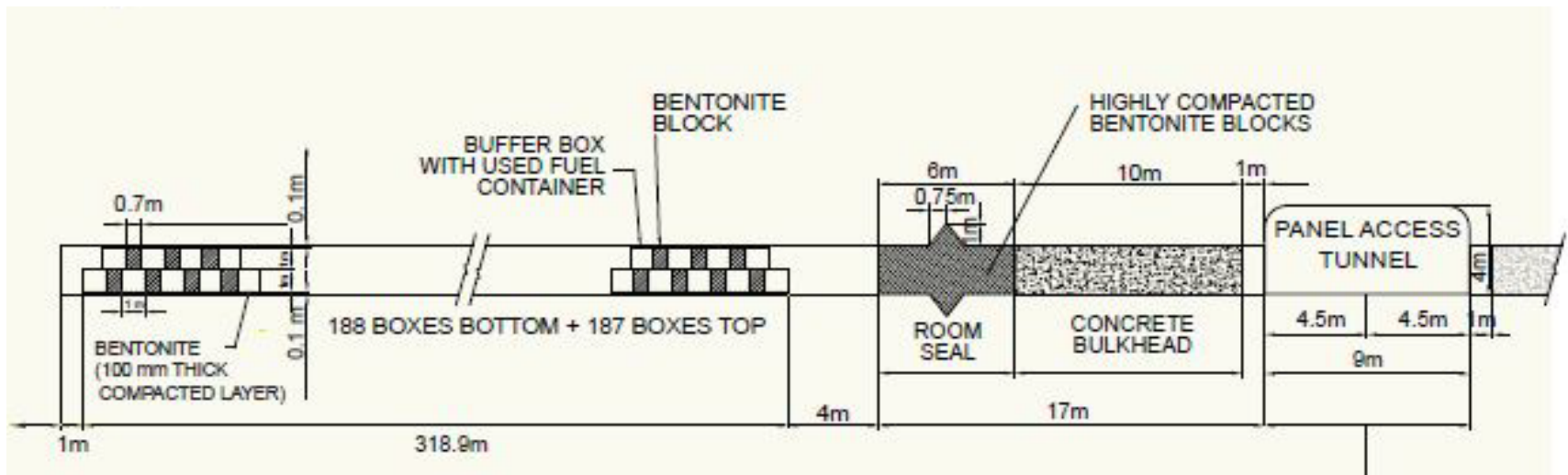
Used Fuel Emplacement



Used Fuel Emplacement – Cont'd



Used Fuel Emplacement – Con't



Integrated Technical Assessments

- Engineered barrier design is transitioning from concept and R&D to performance testing
- Siting technical assessments are integrated between geoscience, engineering, environment and safety
- Iterative assessments planned to reflect the level of information available through site selection
- Preliminary safety case development will incorporate data from engineered barrier proof testing and field data

Technical Research & Collaboration

- Broad based research program to investigate aspects relevant to Canadian repository, in order to build confidence and reduce uncertainties
- NWMO maintains watching brief on alternative technologies
- NWMO sponsored research contracts at 15 Canadian university groups and 2 foreign universities in 2015
- NWMO continued to participate in research at URLs in Switzerland, Sweden, Finland; and joint studies with other international groups such as NEA
- Produce several reports, papers and journal articles annually

Long-term Management of Used Nuclear Fuel

Working together on a shared global priority



NWMO's International Co-operation

NWMO signed co-operation agreements with:

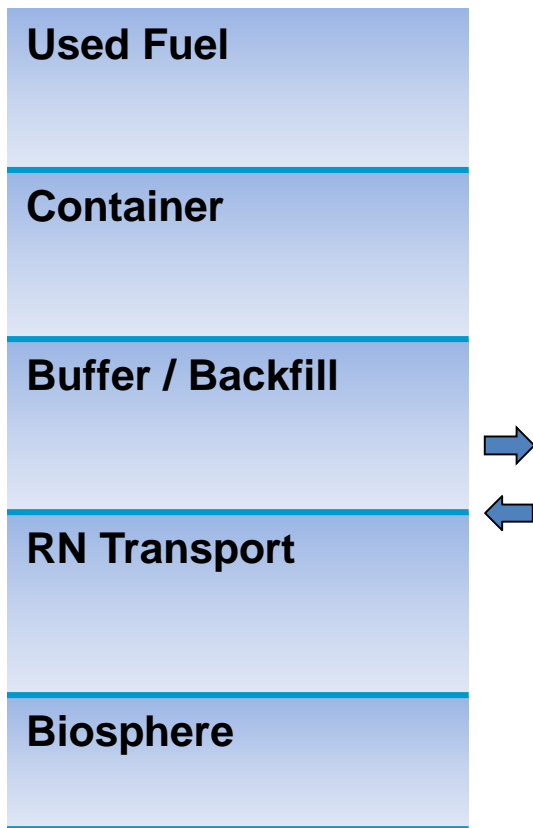
- Finland
- Sweden
- France
- United Kingdom
- Switzerland
- South Korea

NWMO is active in international organizations:

- Nuclear Energy Agency (NEA) of OECD
- International Atomic Energy Agency (IAEA)



Near Field & Biosphere



Used Fuel Dissolution

- Continued studies in UWO Chair program

Container

- Criticality
- Temperature inside containers

Buffer / Backfill

- Properties of bentonite buffer
- THM modelling of near-field

Mass Transport

- Solubility /Thermodynamic database
- Modelling of gas transport
- Improvements in T2GGM gas transport model
- Improvements in SYVAC3-CC4 nuclide transport model

Biosphere

- Updated models & data for biota dose assessment
- Reference values for non-radiological hazards

Geosciences

Geology

Hydrogeology

Hydrogeochemistry

Microbiology

Geomechanics

Seismicity

Climate Change

Paleohydrogeology



Geosphere Stability/Evolution

Long-term Climate Change

- Glacial Systems Model
- Greenland Analogue Project

Seismicity

- Neotectonics/Paleoseismicity

Groundwater System Evolution – Case Studies

- Deep Seated Groundwater System Evolution
- Reactive Transport Modelling

Site Characterization: Methods (examples)

- Matrix Porewater Characterisation
- Radionuclide Transport Properties – Sorption
- Thermal, Hydraulic & Mechanical Properties (THM)
- Excavation Damage Zone Assessment
- Site-specific Natural Analogues
- Discrete Fracture Network Realization
- International URL's (Aspo; ONKALO; Mt. Terri; Grimsel)



Questions?