

Development of the Canadian Used Fuel Repository Engineered Barrier System

- *Background*
- *Evolution of the system*
- *Engineering details*
- *Progress to date*

Future work



Canada's nuclear energy program

22 CANDU reactors

A number of research reactors

currently:

- 2.6 million used fuel bundles

- 50,000 tonnes

plan:

- 100,000 tonnes



Canada's plan is to place the used nuclear fuel in a deep geological repository

- ✓ *AECL*
- ✓ *SKB*
- ✓ *Posiva*
- Andra*
- ONDRAF*

NWMO reference

- Steel core for strength
- Copper corrosion barrier
- Bentonite buffer

Reversible

Great engineering solution
but - concrete is too unpredictable

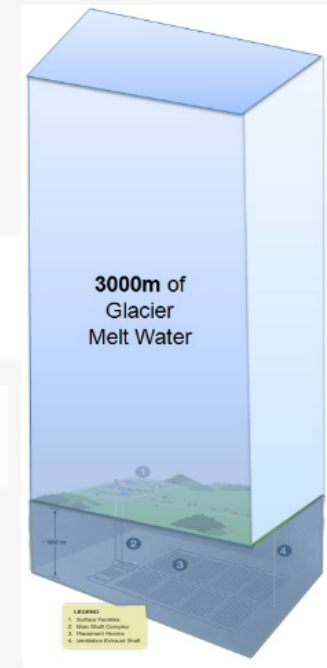
Repository container loads

Hydrostatic 800 meter water column 8 MPa

Lithostatic 0 MPa

Buffer Swelling Sedimentary 2 MPa
Crystalline 7 MPa

Glacial 3 kilometers of ice 30 MPa



Maximum load = 38 MPa

Design req 4.5 MPa

How much copper?

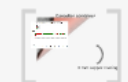
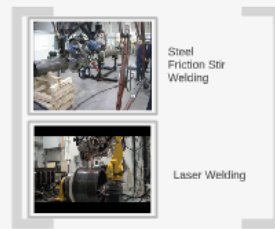
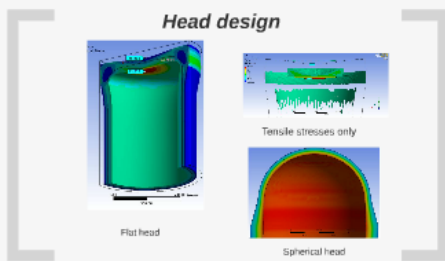
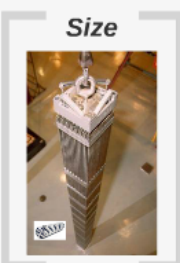
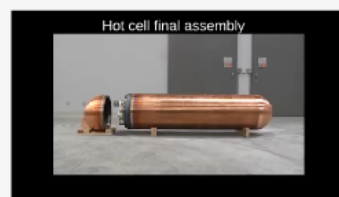
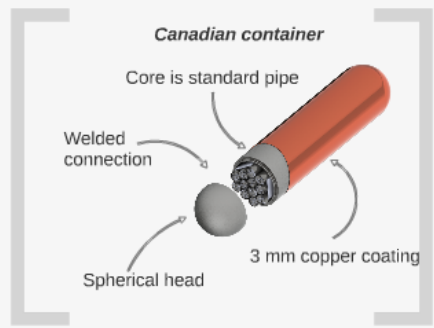
- Oxidation
- Miscellaneous
- Microbiologically influenced corrosion

Total corrosion allowance:
100,000 years - 0.4 mm
1,000,000 years - 1.27 mm

Say 3 mm



Repository container



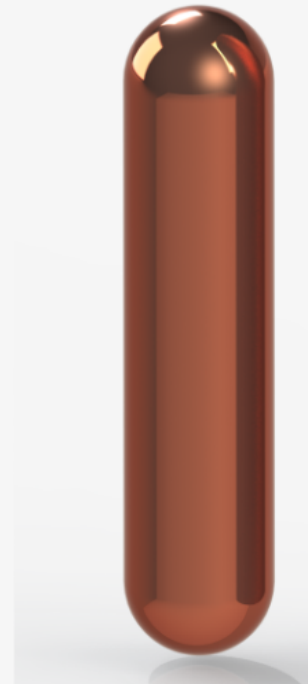
Containers investigated



Reference
360 bundles



European
288 bundles



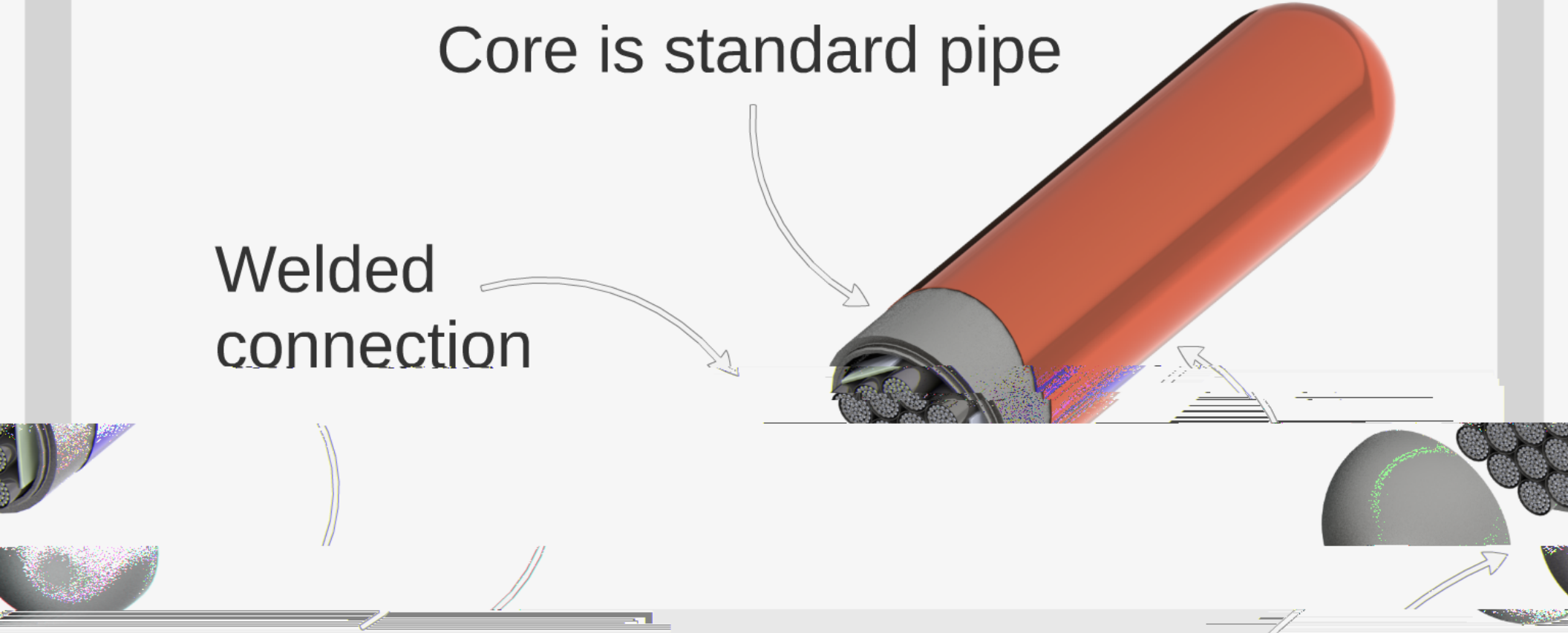
Canadian
48 bundles



Canadian container

Core is standard pipe

Welded connection

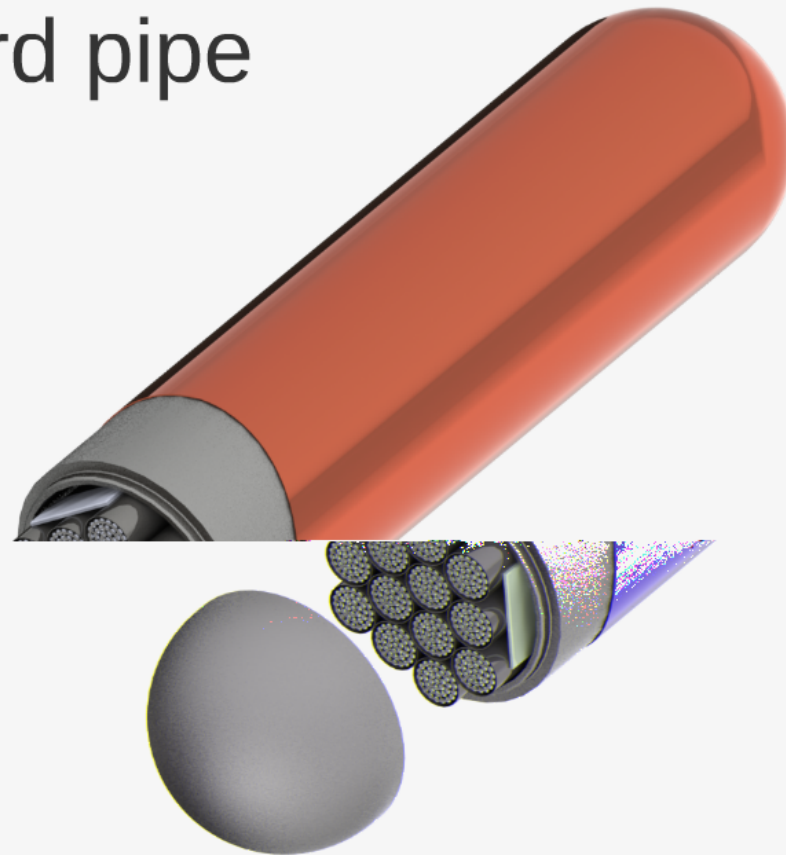


3 mm copper coating
Spherical head

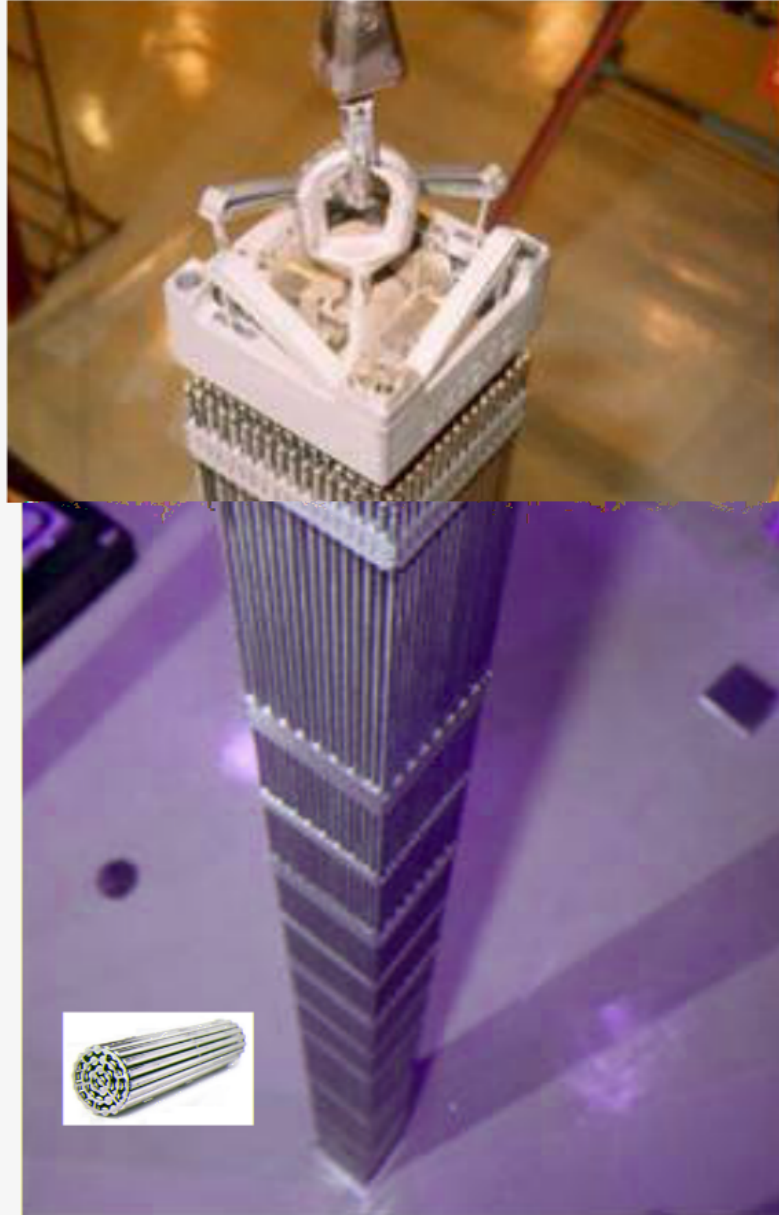


Canadian container

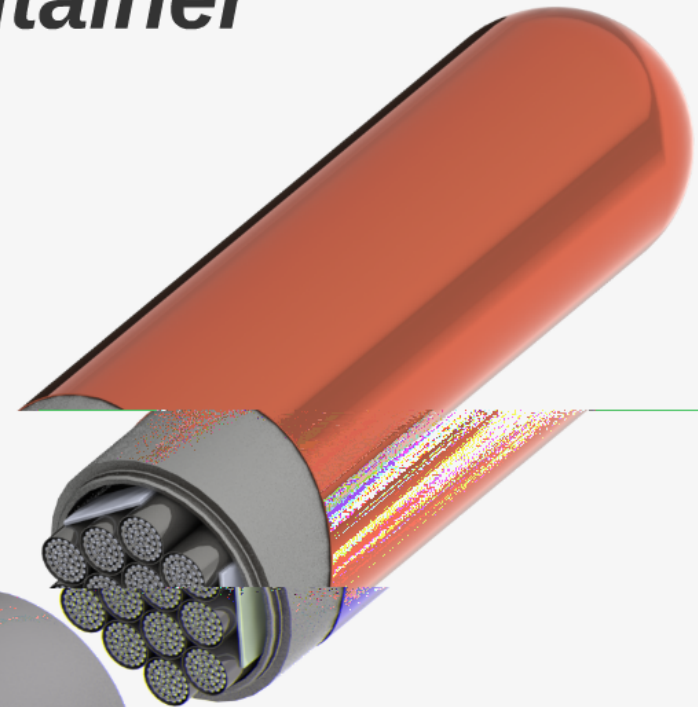
Core is standard pipe



Size

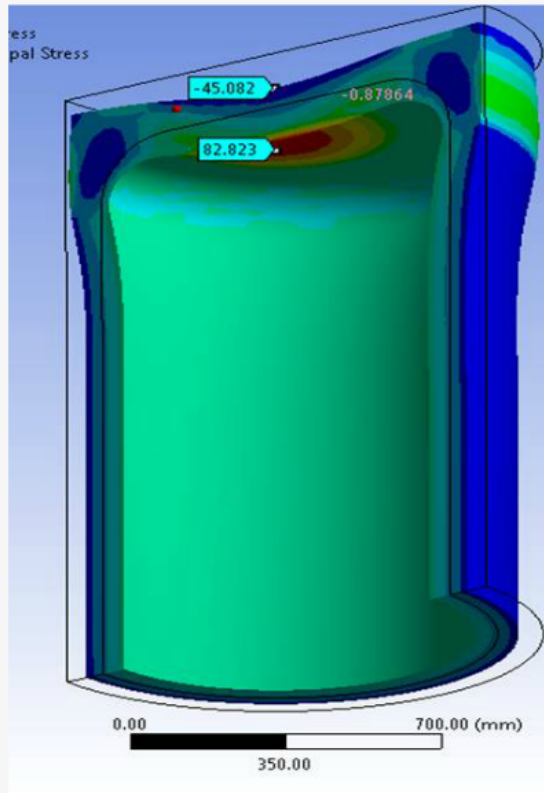


Canadian container

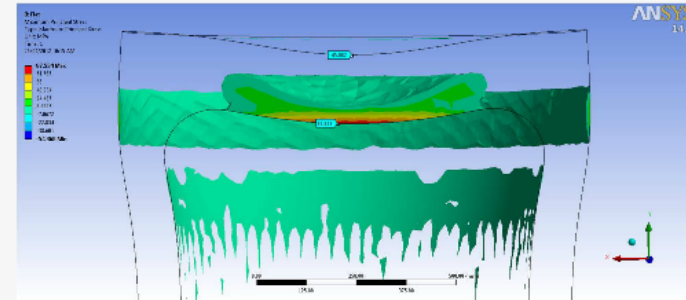


Spherical head

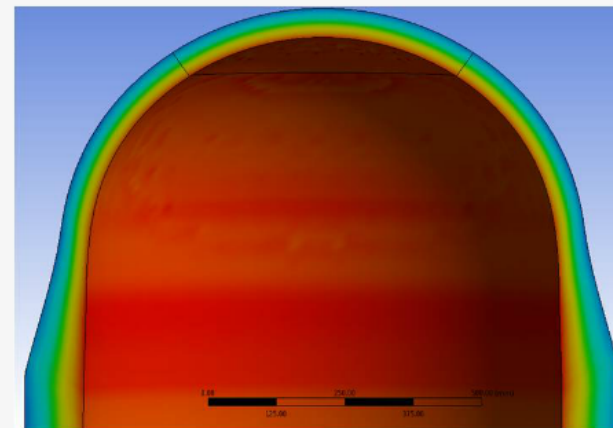
Head design



Flat head



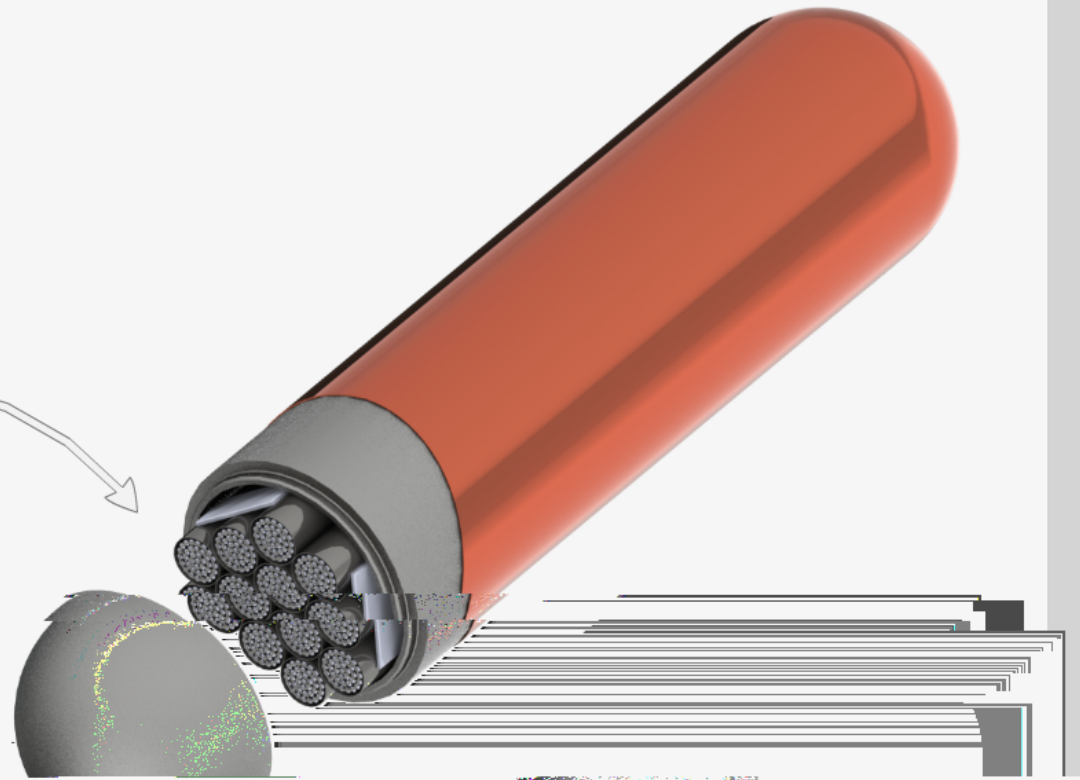
Tensile stresses only

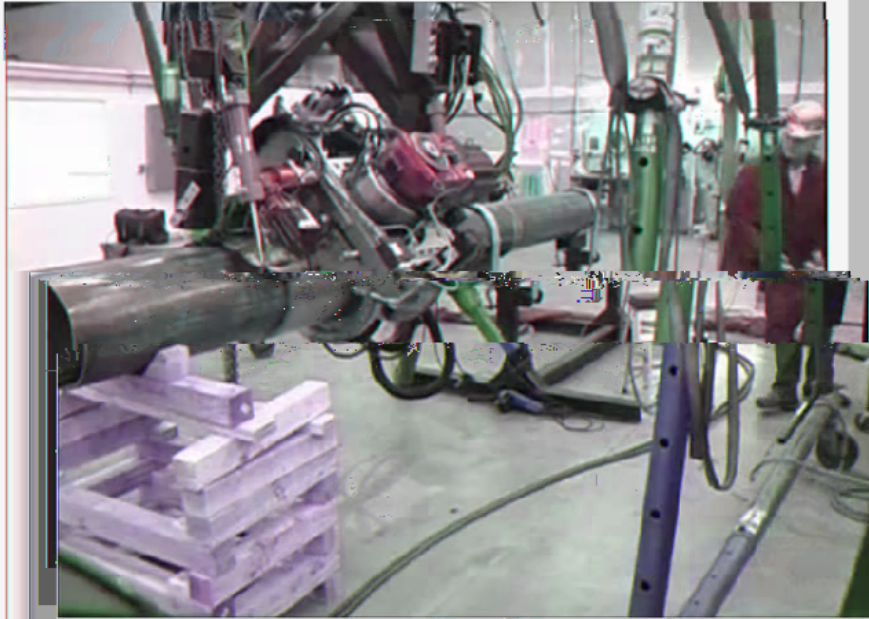


Spherical head

Canadian container

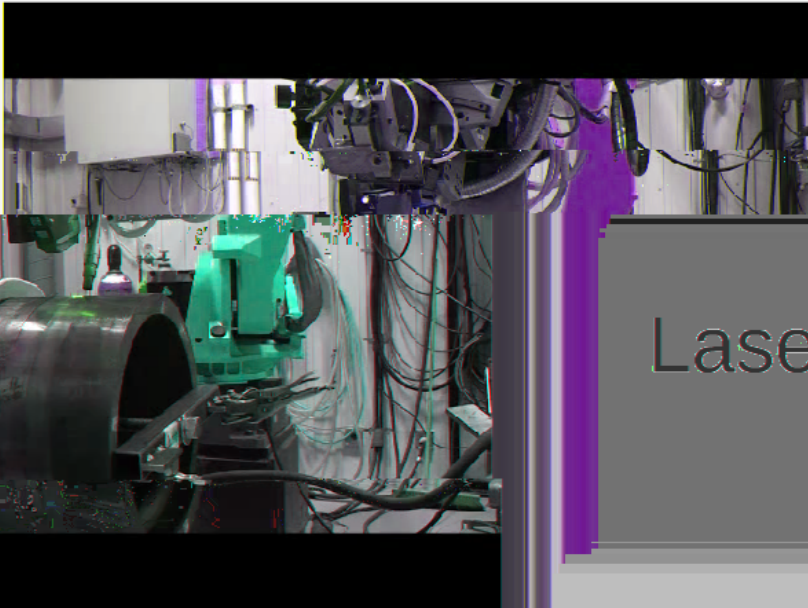
Welded
connection





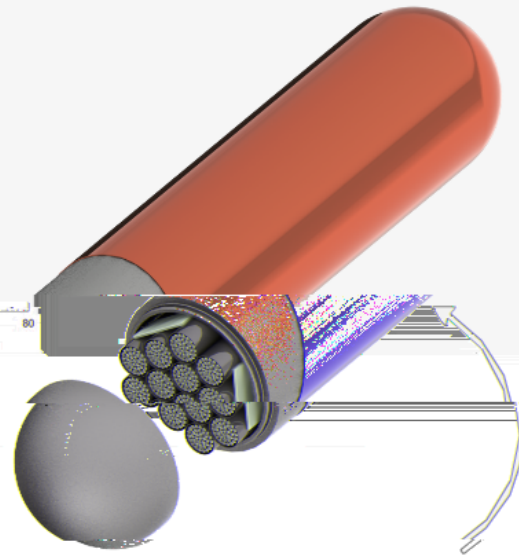
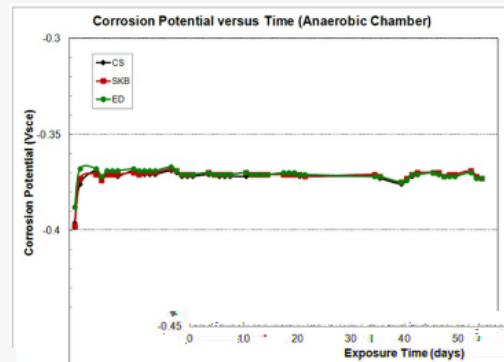
Steel

Welding



Laser Welding

Canadian container



3 mm copper coating

Cold spray coating



Cold Spray PCS-304
PLASMA

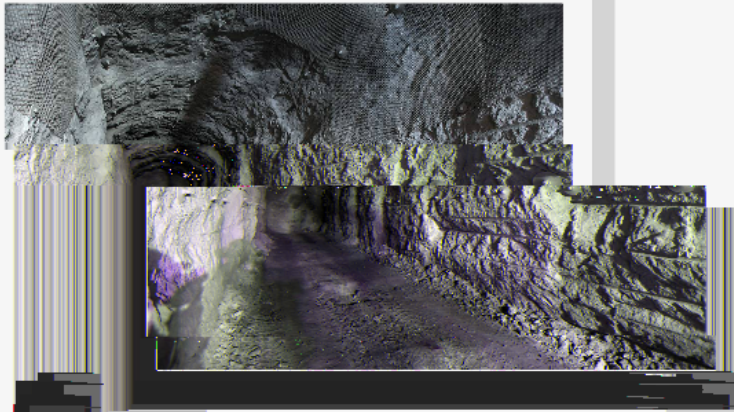
Hot cell final assembly



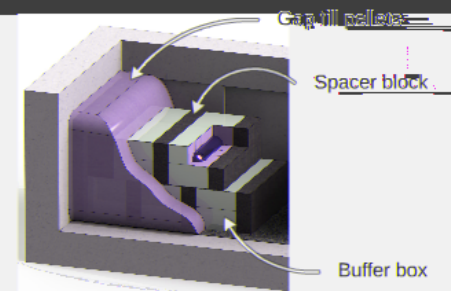
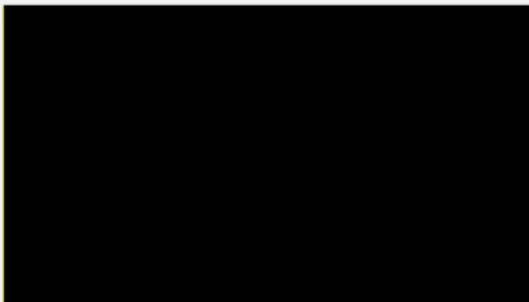
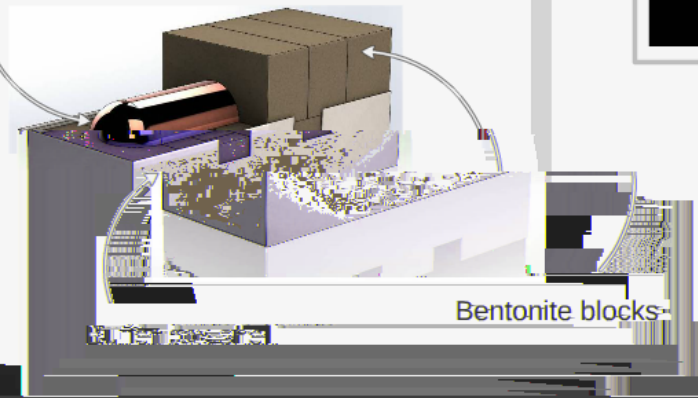


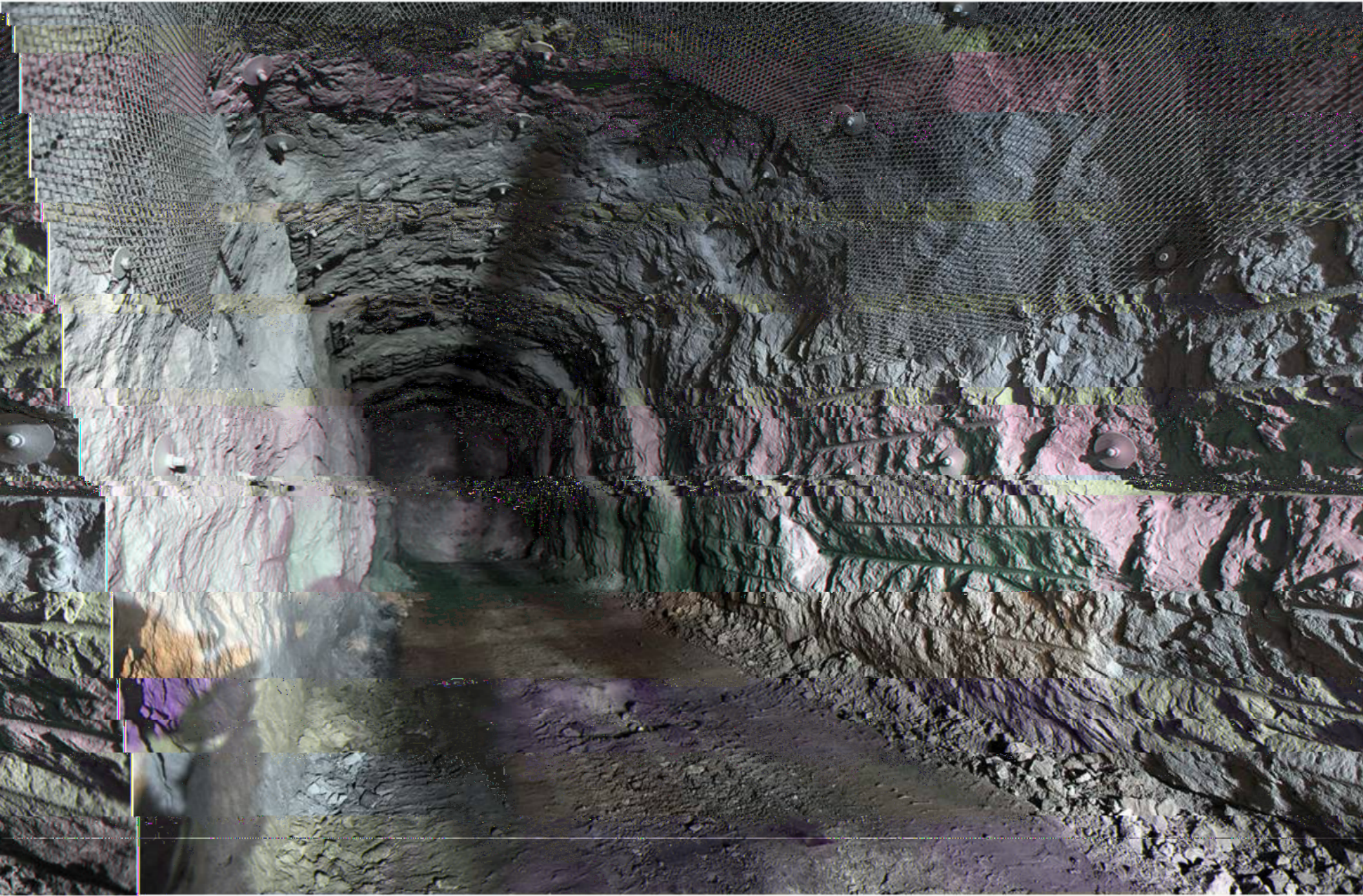
Repository emplacement

Drill and blast

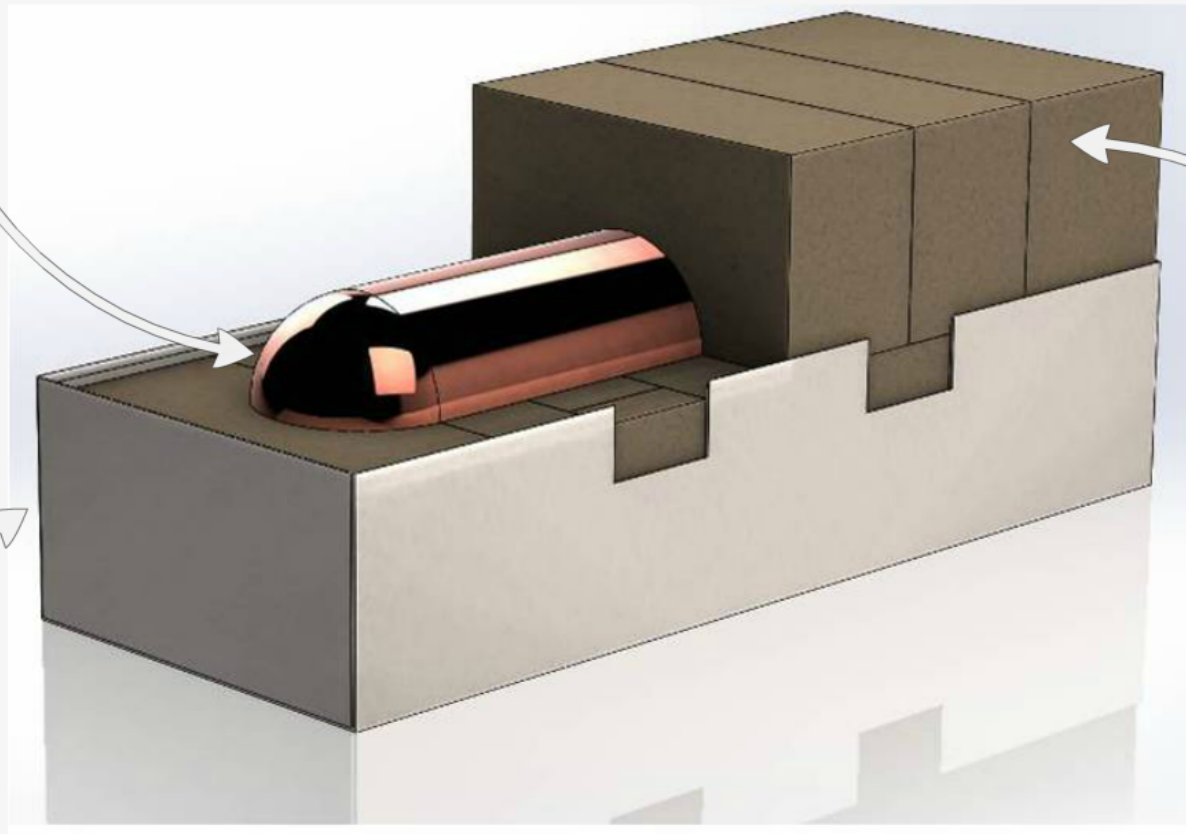


Used fuel container





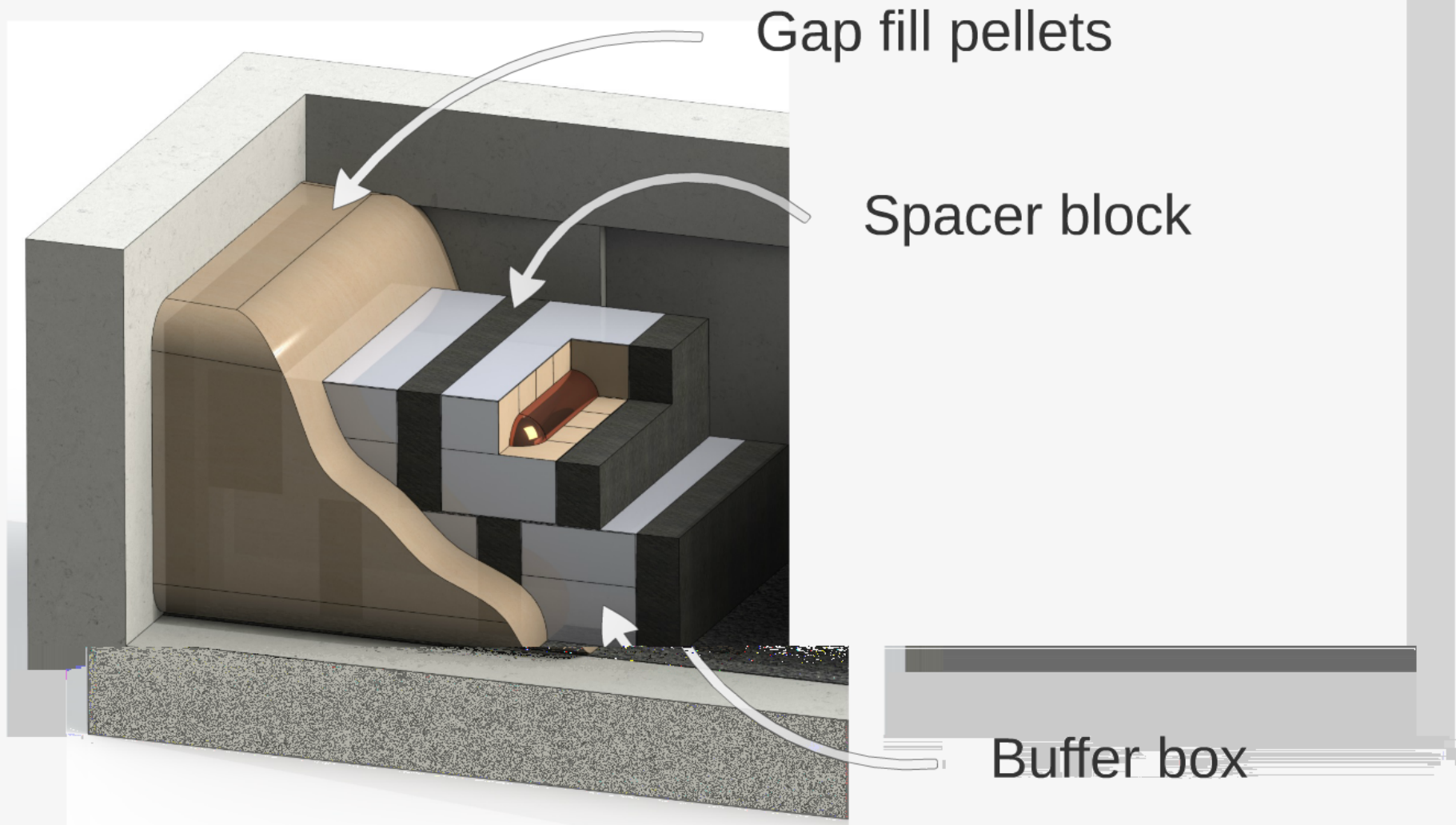
Used fuel container



Buffer box shell

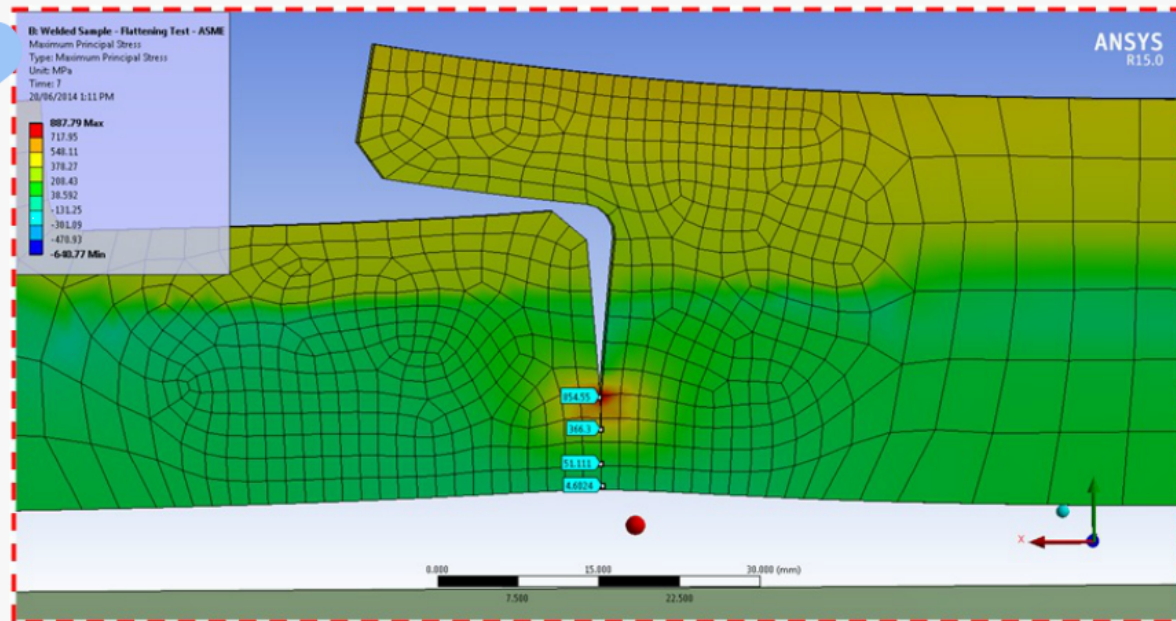
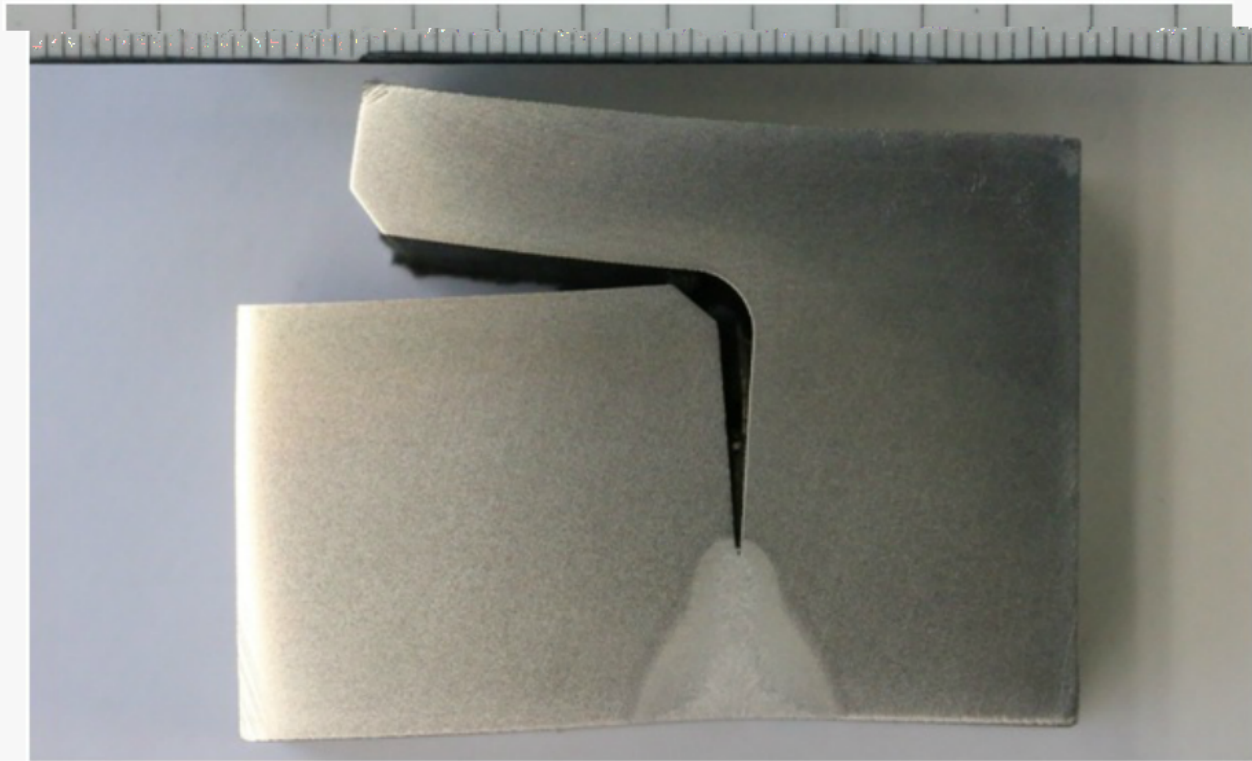
Bentonite blocks

Emplacement system

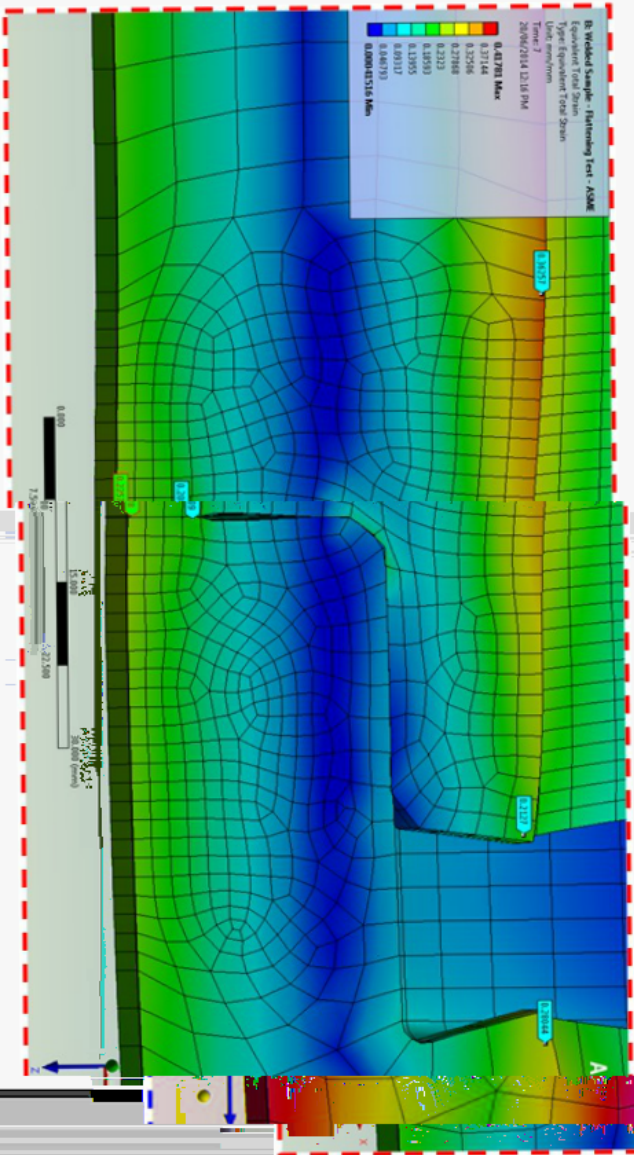












NSYS
RISE