

# *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

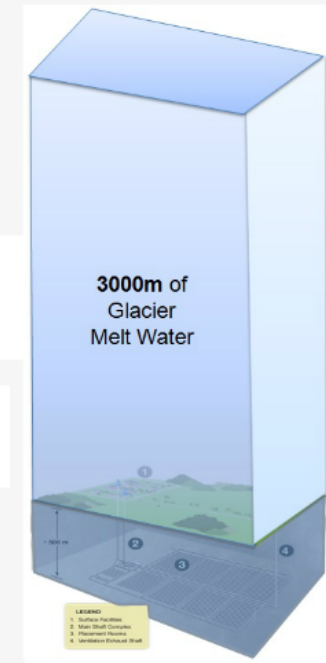
## Repository container loads

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 for 45 MPa**

## *How much copper?*

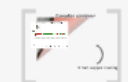
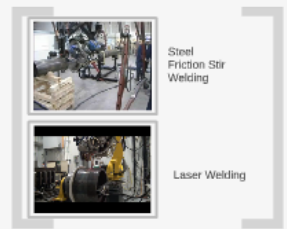
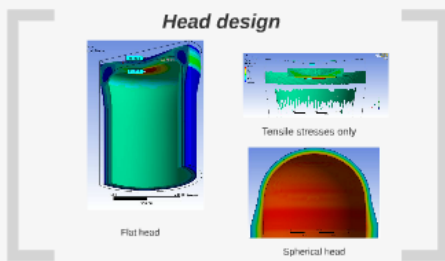
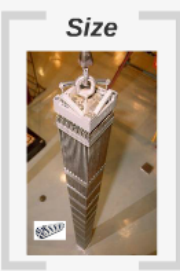
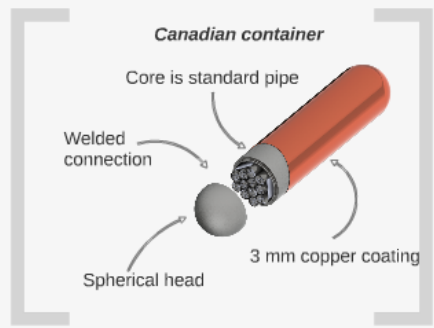
- Oxidation
- Miscellaneous
- Microbiologically influenced corrosion

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

Say 3 mm



# Repository container



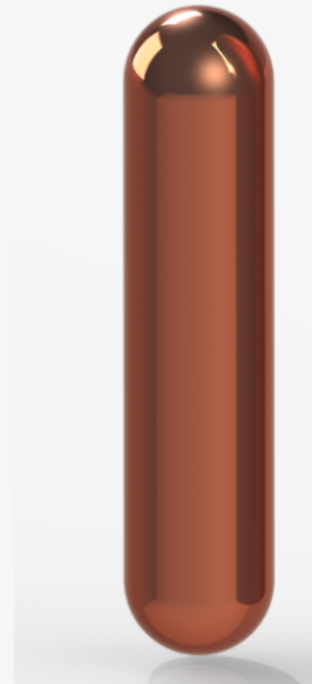
*Containers investigated*



Reference  
360 bundles



European  
288 bundles



Canadian  
48 bundles



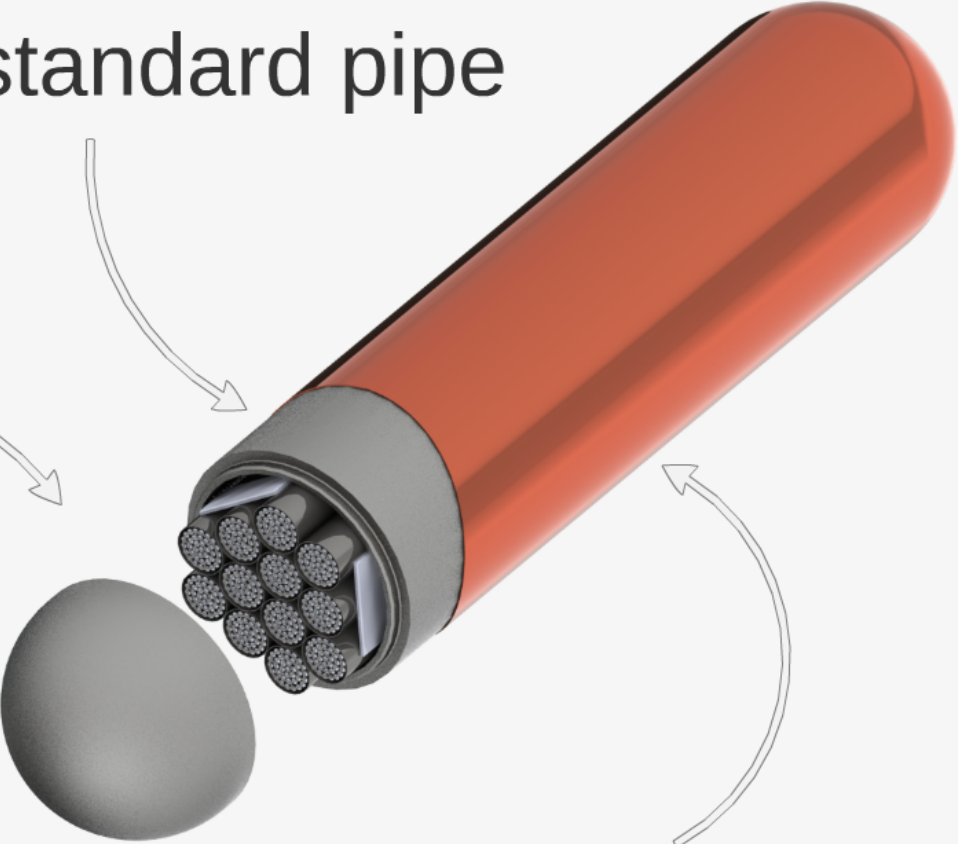
# *Canadian container*

Core is standard pipe

Welded connection

Spherical head

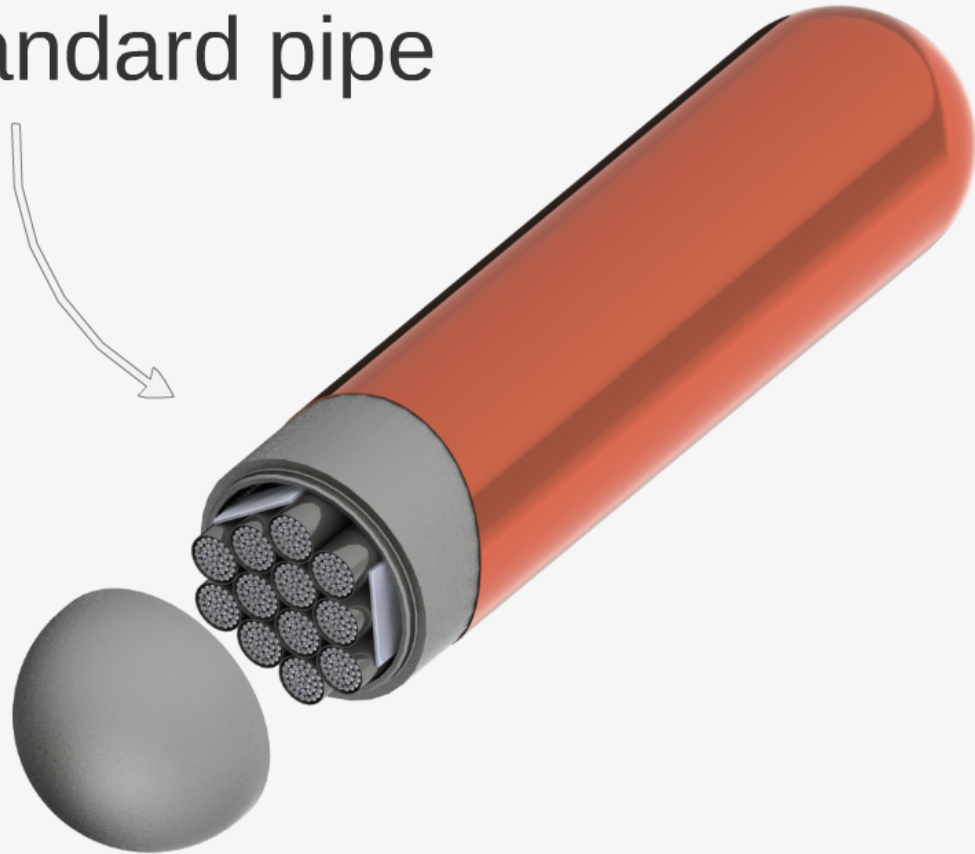
3 mm copper coating





# *Canadian container*

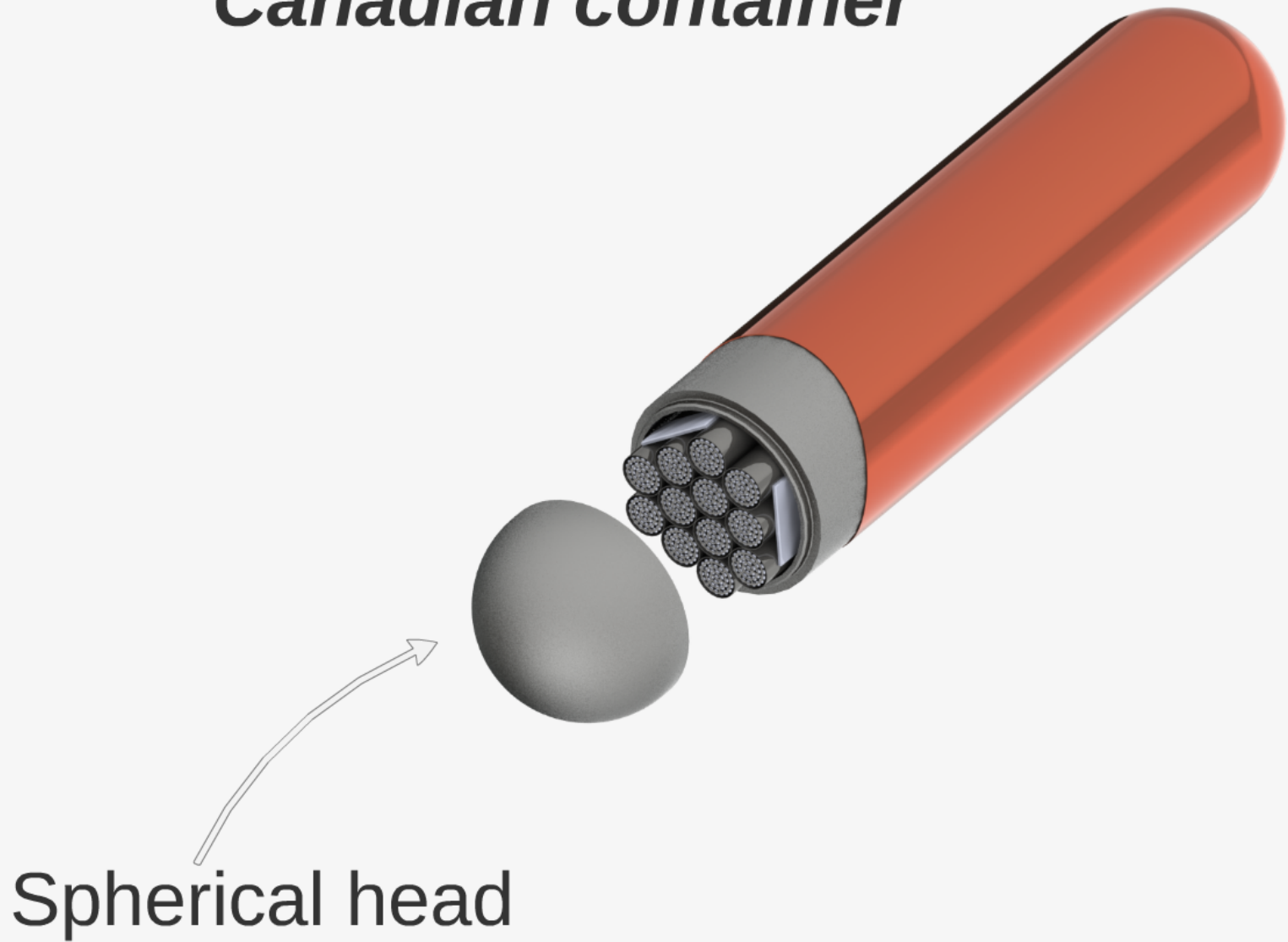
Core is standard pipe



# *Size*

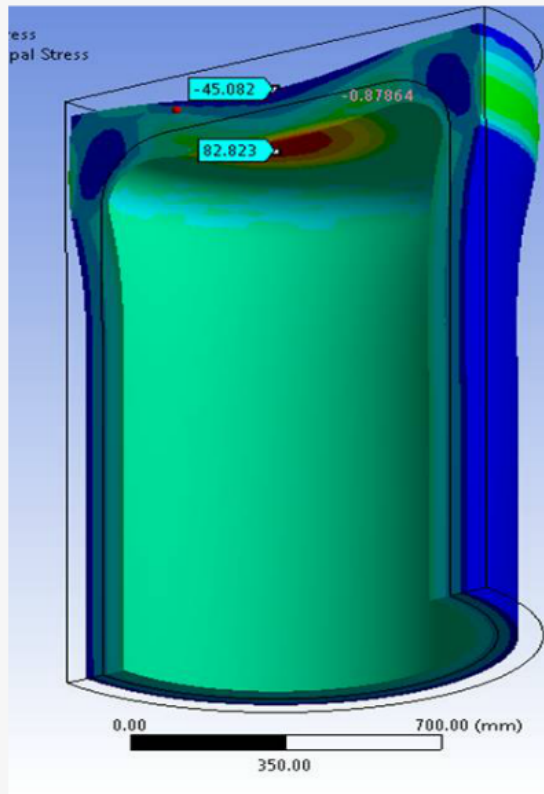


# *Canadian container*

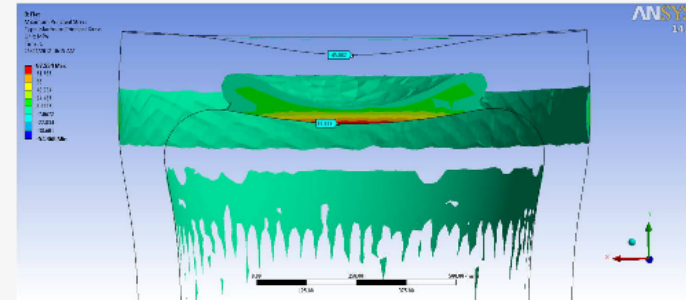


Spherical head

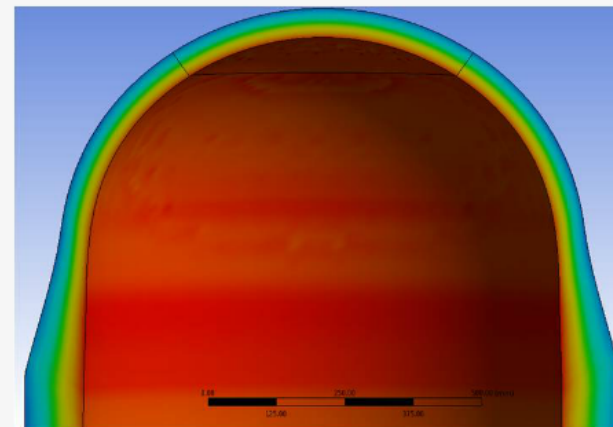
# Head design



Flat head



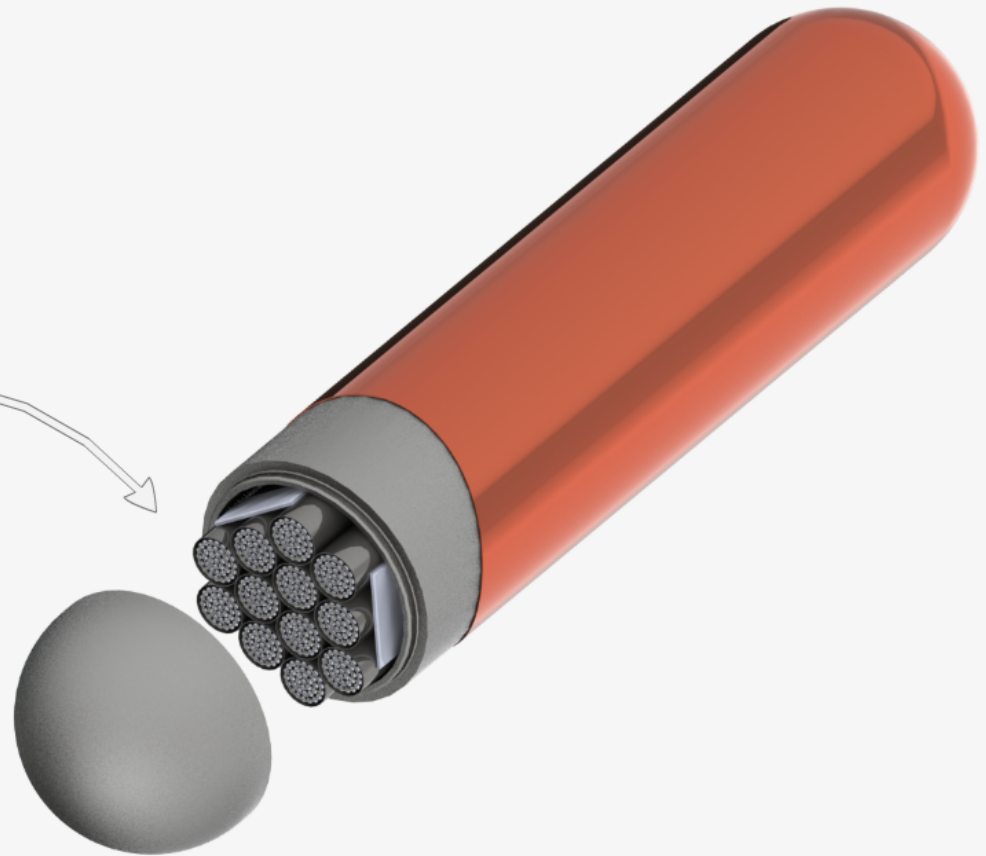
Tensile stresses only



Spherical head

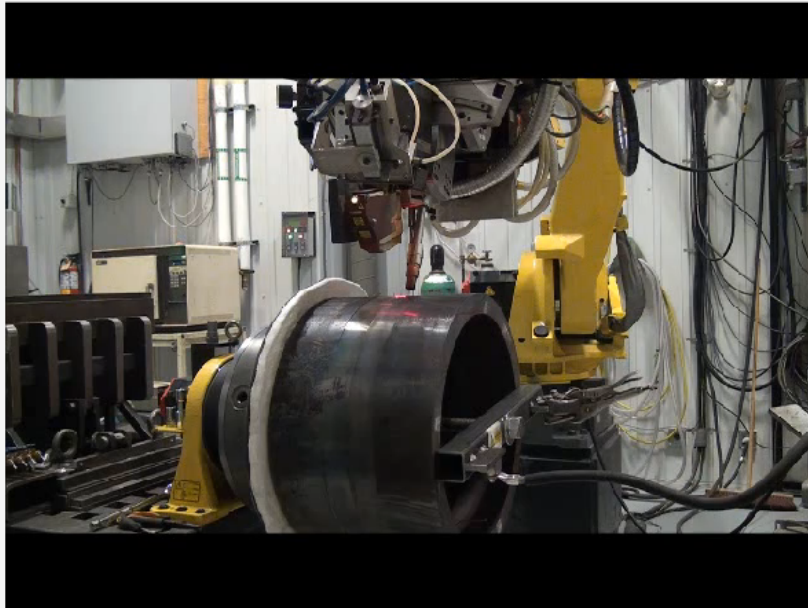
# *Canadian container*

Welded  
connection



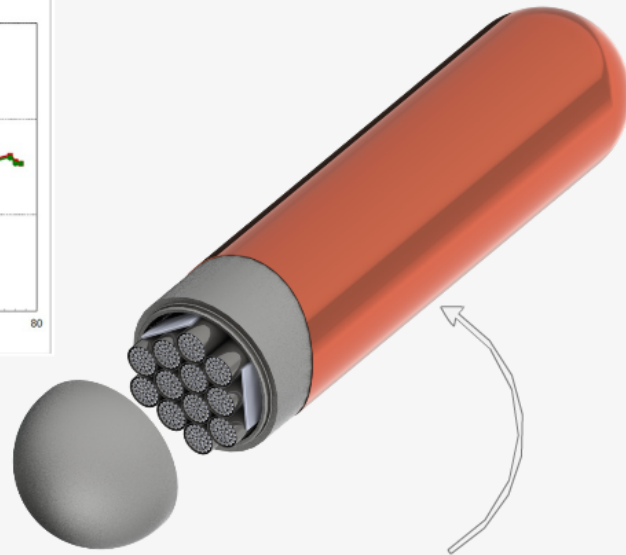
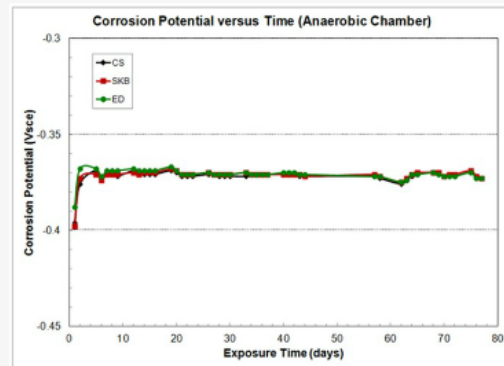


Steel  
Friction Stir  
Welding



Laser Welding

## *Canadian container*



3 mm copper coating

# *Cold spray coating*



*Cold Spray PCS-304*  
**PLASMA**



# Hot cell final assembly



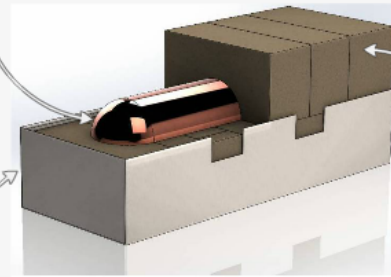


# Repository emplacement

*Drill and blast*



Used fuel container

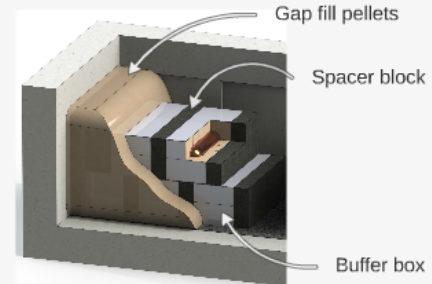


Buffer box shell

Bentonite blocks



*Emplacement system*



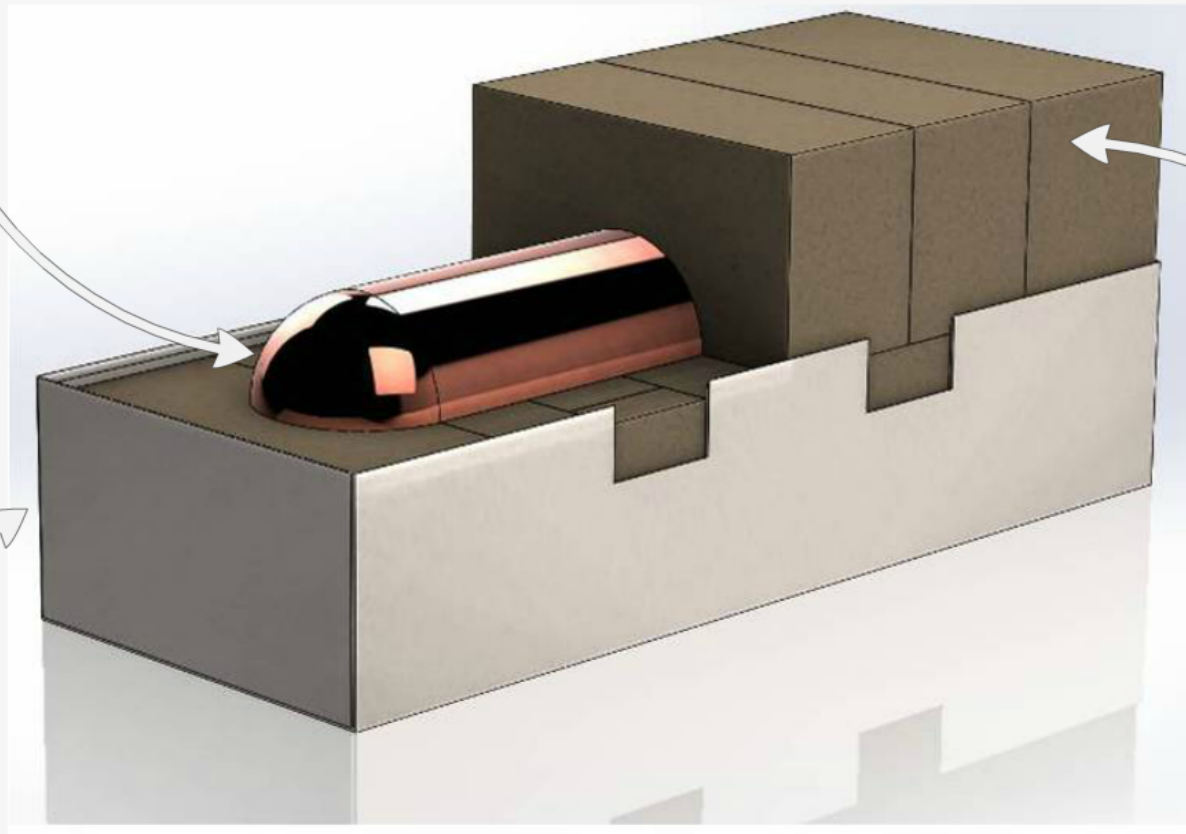
Gap fill pellets

Spacer block

Buffer box



Used fuel container



Buffer box shell

Bentonite blocks

# *Emplacement system*

