

# Belgian program on near surface disposal

## PA Community of Practice Richland

*V. Nys*

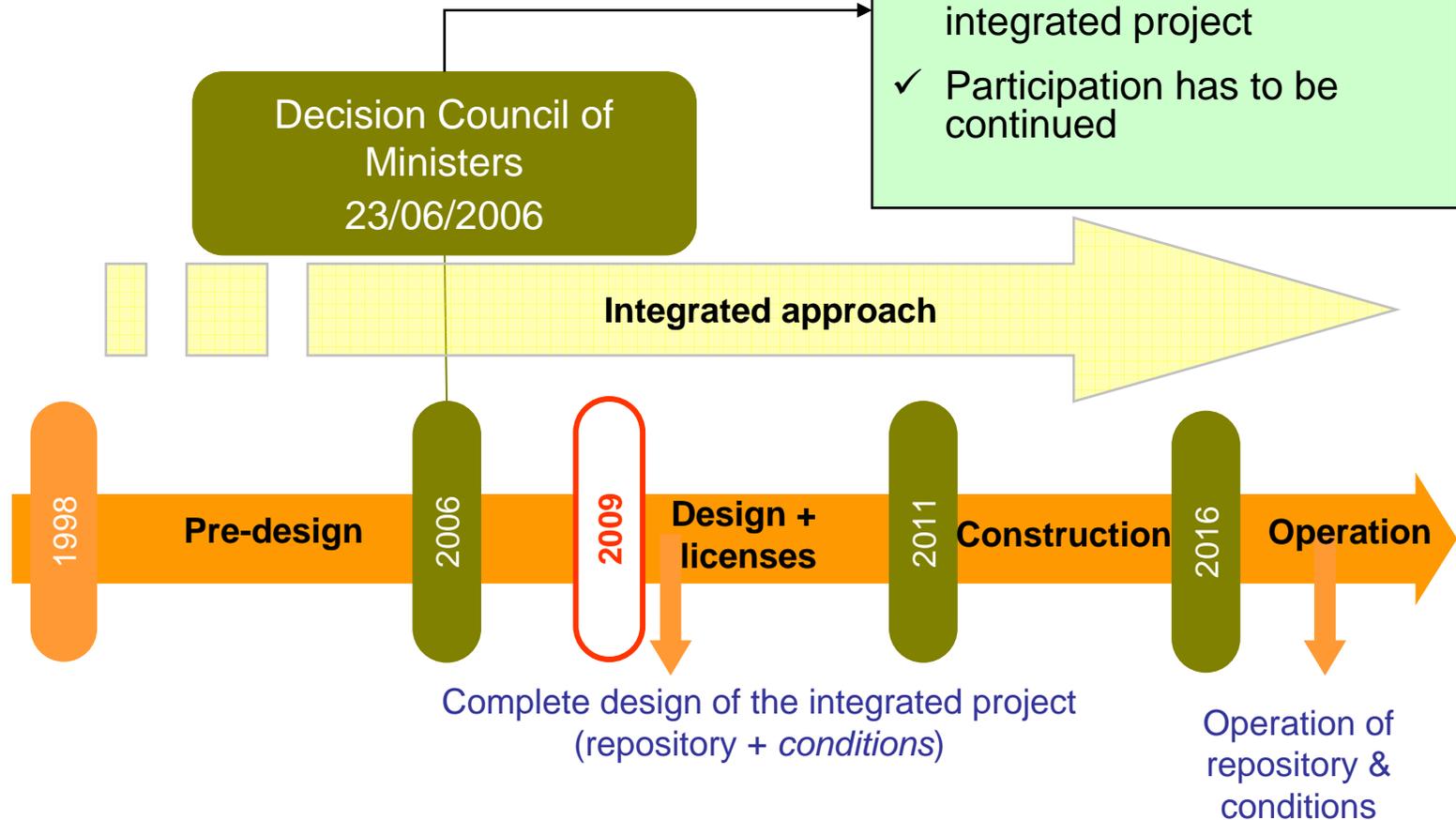
*FANC (Federal Agency of Nuclear Control), Belgium*

# Layout

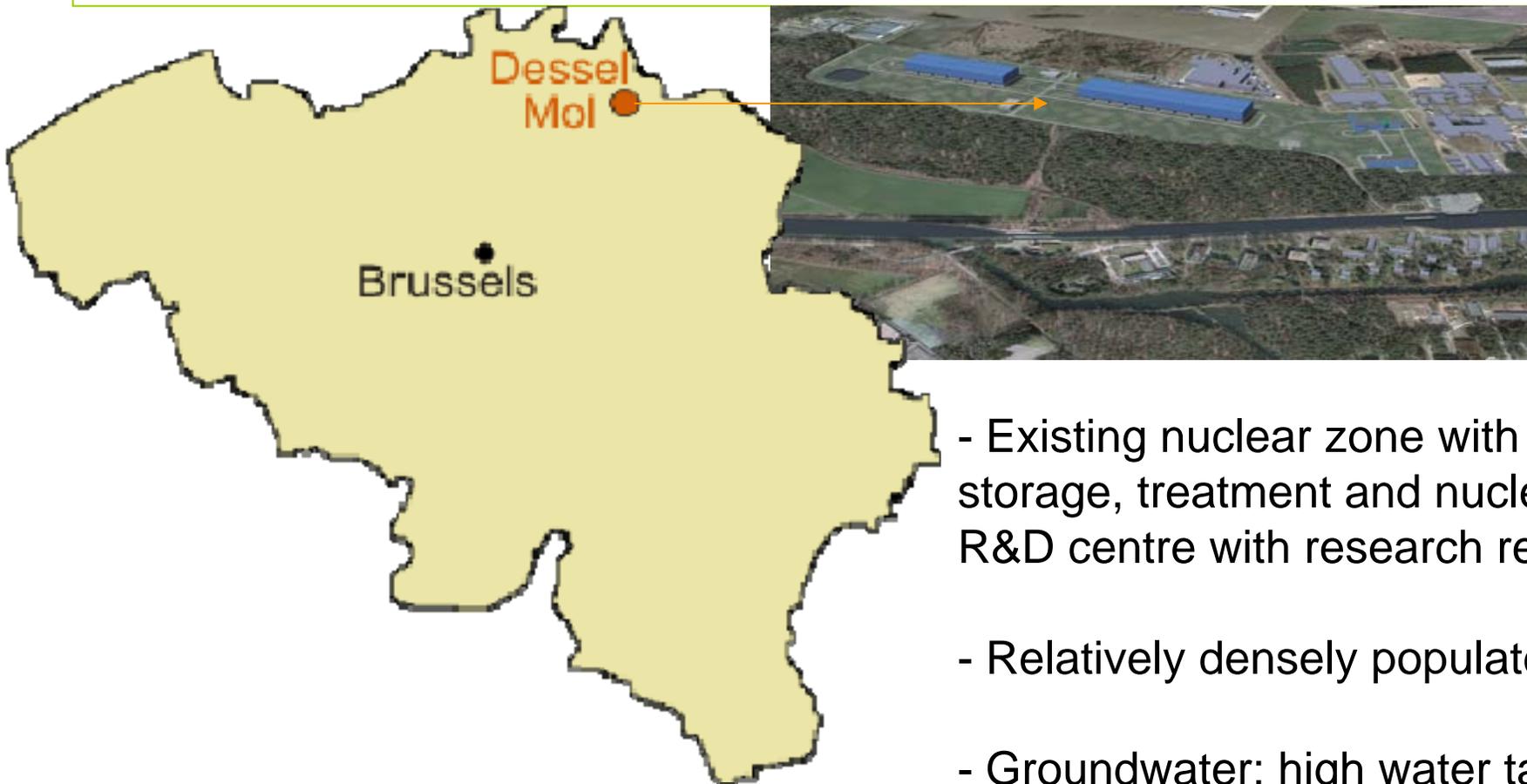
- **Belgium near surface disposal**
  - **Schedule**
  - **Concept**
- **Safety approach and safety concept**
- **Points of concerns and open questions**

# Belgium context Results of the pre-design

- ✓ Surface disposal in Dessel
- ✓ Development of an integrated project
- ✓ Participation has to be continued



# Near Surface Disposal Concept

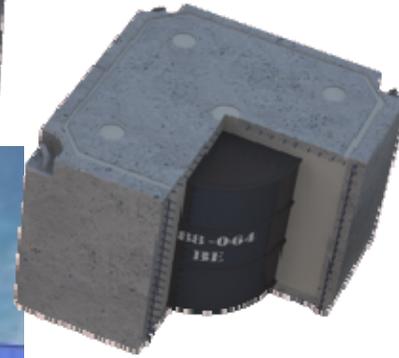


- Existing nuclear zone with waste storage, treatment and nuclear R&D centre with research reactors
- Relatively densely populated
- Groundwater: high water table, used for human consumption

# Near Surface Disposal Concept Disposal Design

## 3 types of monoliths:

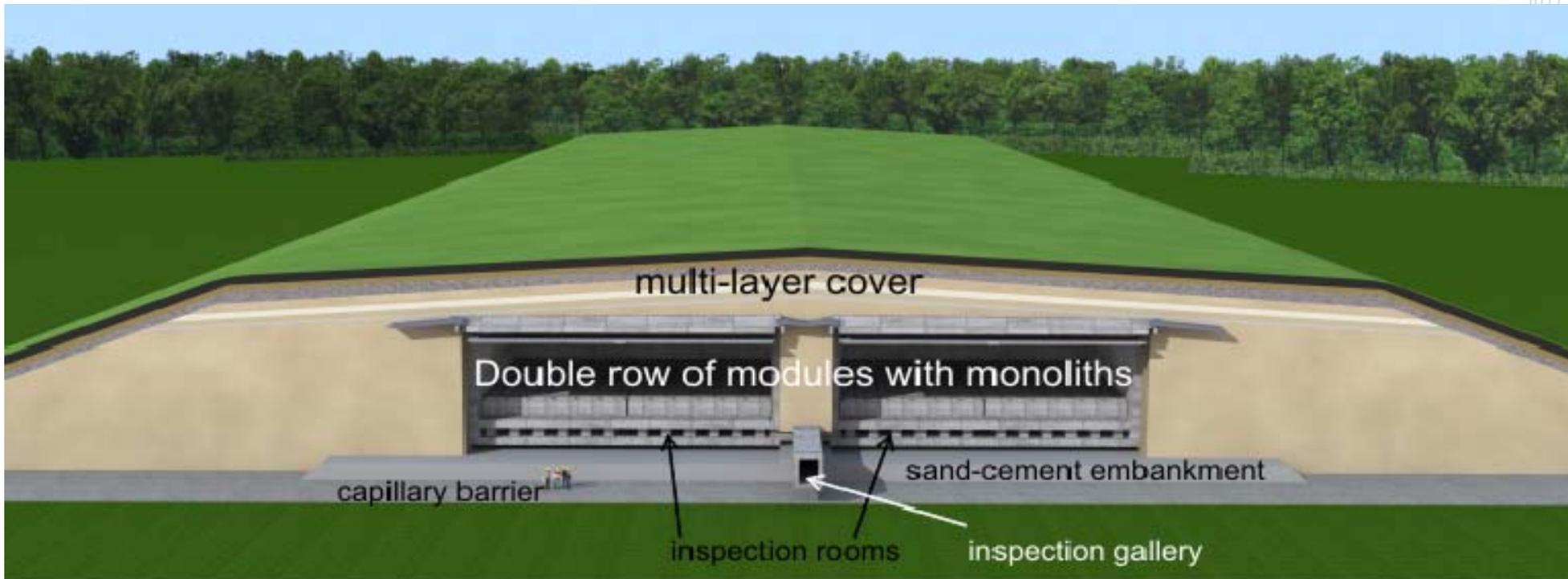
1. Standardised waste drums
2. Non-standard (historical) waste drums
3. Bulk waste (larger pieces decommissioning)



## Disposal facility:

1. Vault type
2. Fixed steel roof attached to modules
3. Inspection room
4. Inspection gallery

# Near Surface Disposal Concept Disposal Design



# Safety Approach

Two main long-term safety functions are defined:

1. **Delay and attenuation of the releases (R)** in order to retain the contaminants for as long as required within the near surface facility (or disposal system). Three sub-functions are defined:
  - Limitation of contaminant releases from the waste forms (R1)
  - Limitation of the water flow through the disposal system (R2)
  - Retardation of contaminant migration (R3)
  
2. **Isolation (I)** of the waste from humans and the biosphere for as long as required, by preventing direct access to the waste and by protecting the disposal facility from the potentially detrimental processes occurring in the environment of the disposal facility. Two sub-functions are defined:
  - Reduction of the likelihood of inadvertent human intrusion and of its possible consequences (I1)
  - Ensuring stable conditions for the disposed waste and the system components (I2)

# Safety Concept (partial view)

	<b>Before regulatory release of the site</b>	<b>After regulatory release of the site</b>
Open inspection rooms/ galleries	Containment in disposal facility, Monitoring	Not applicable
Filled inspection rooms	Not Applicable	(I1), I2, R3
Multi-layer cover	I1, I2, R2	(I1), I2
Module concrete roof	I1, I2, R2	(I1), I2
Module wall	I1, I2	(I1), I2
Concrete container	I1, I2, R2, R3	(I1), I2, R3
Cementitious backfill of concrete container	R2, R3	R3
Module floors	I1, I2, R2, (R3)	(I1), I2, R3
Embankment	I2	I2

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Multi-layer cover	I1, I2, R2	(I1), I2
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<b>Module wall</b>	I1, I2	(I1), I2
<b>Concrete container</b>	I1, I2, <b>R2</b> , R3	(I1), I2, <b>R3</b>
<b>Cementitious backfill of concrete container</b>	<b>R2</b> , R3	<b>R3</b>
<b>Module floors</b>	I1, I2, <b>R2</b> , (R3)	(I1), I2, <b>R3</b>
Embankment	I2	I2

# Points of Concerns

- From the aforementioned information, safety of the concept relies mainly on cementitious components
- In consequence, FANC (Belgian Safety Authority) pays particular attention to the degradation processes of the cementitious components and their impact on safety functions
  - time frame during which the containment properties of the components can be assumed (and to which extent) ?

# Points of Concerns

- Based on literature review the FANC classified from FEPs list, FEPs affecting cementitious components durability with time
  - Physical degradation modes
  - Chemical degradation modes
  - Steel reinforcement degradation modes
- For each degradation mode, its primary manifestation is identified together with its cause
- The aim is to assess the significance of each degradation mode for L-T safety
- Coupling effects should be taken into account

# Example for Cracking Likelihood

	Foundation slab	Columns	Module floor	Module floor slabs	Inspection room fill	Module walls	Metallic roof concrete support	Precast roof slab	Small mortar layer	Roof structural slab	Non-structural top-slab	Floating slab	Monolith container	Monolith fill mortar	Monolith lid
Freeze - thaw	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15
Fatigue-vibration	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15
Settlement	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15
Plastic shrinkage	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15
Plastic settlement	E1	E2	E3	E4	E5	E6	E7	E8	E9	E10	E11	E12	E13	E14	E15
Early thermal contr	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
Drying shrinkage	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15
Over loads	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15
Creep	I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	I12	I13	I14	I15
Sulfate attack	J1	J2	J3	J4	J5	J6	J7	J8	J9	J10	J11	J12	J13	J14	J15
ISA DEF	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15
Alkali aggre react.	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15
Reinforc. Corrosion	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15

	High risk
	Moderate risk
	Slight risk
	No risk
	Risk not known

# Open Questions

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  - ...
- Issues on what could be confirmed through “in-situ” tests?

# Conclusions

- In the Belgian concept, L-T safety relies mainly on cementitious components because of the lack of natural barriers.
- From a regulator point of view, this stresses the need to understand cementitious components L-T behaviour.
  - A particular concern is the time frame during which the containment properties of the components can be assumed (and to which extent)
- Results of PA COP on cementitious barriers could provide reliable references for that concern.

*Thank you for your attention!*