ONDRAF/NIRAS

Disposability of category A waste

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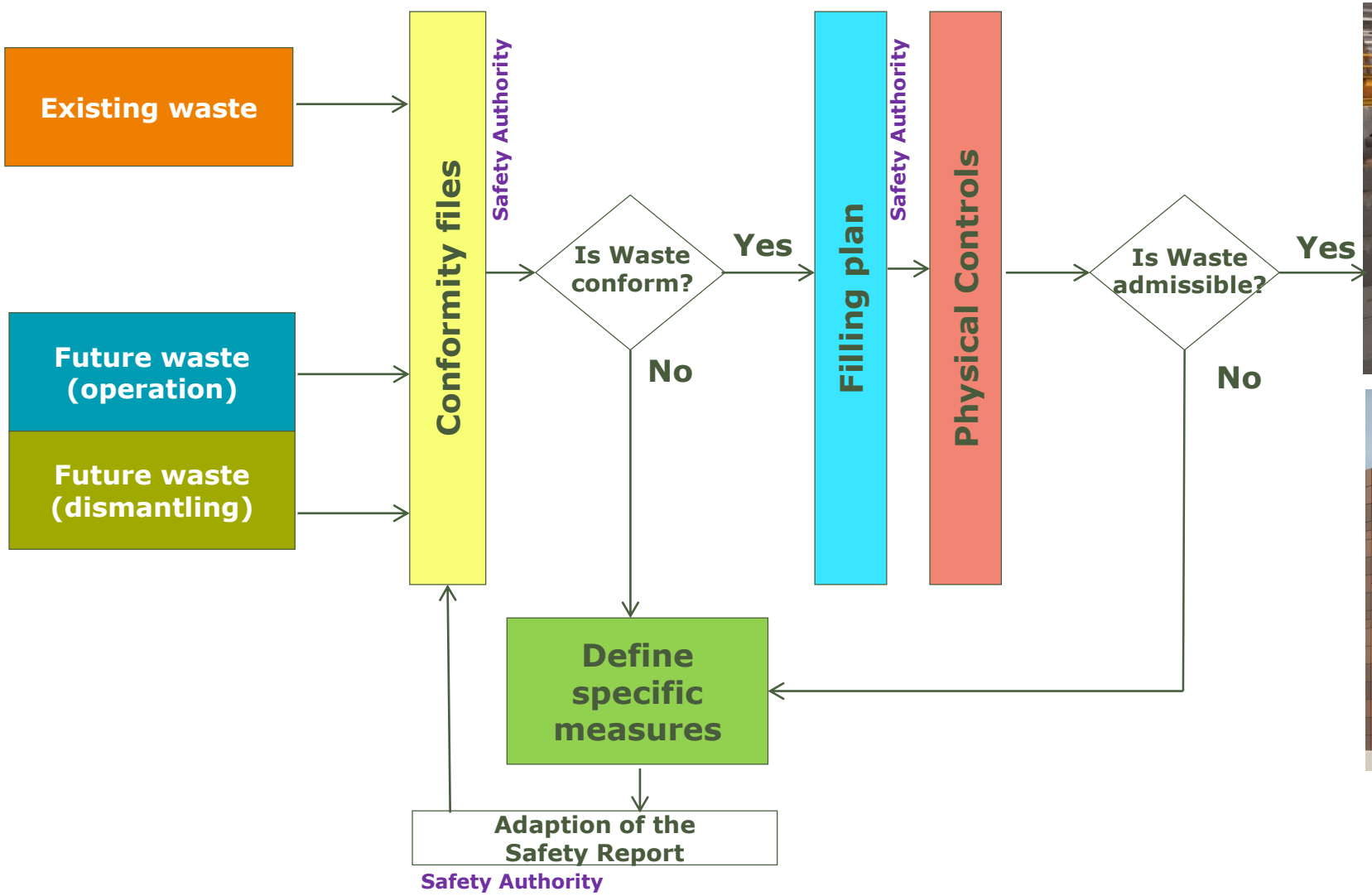
Context

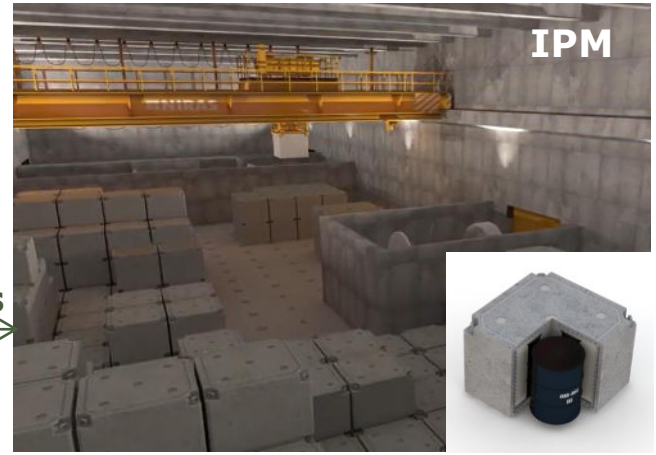
- License application is underway
- Favourable advice (1e Scientific Council)

- Next steps …
  ➔ License with the **License conditions**

- Demonstrate that we are compliant with the **License conditions**
  - Construction
  - **Waste: The waste should not disturb the evolution of the system**
    ➔ ***Demonstration of the "Disposability" of the category A waste***

Demonstration of the “Disposability” of the category A waste : The process





Inventory of category A waste: 32 Modules

Existing waste
Future W - Operation
Future W - Dismantling

Existing waste

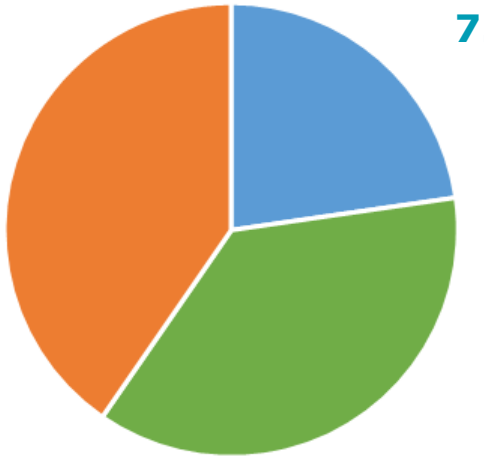
12.8 Modules (40%)

Waste produced based on current ACRIAs (i.e. generic surface disposal)

➔**Filling of the missing information** (to check conformity with the conformity criteria)

➔**Define specific measure** (to ensure the disposability)

➔**Prioritisation of the waste families**



Future waste (operation)

7.2 Modules

Waste will respect the new ACRIAs that are coherent with the conformity criteria of the safety report

➔ ***A priori conform***

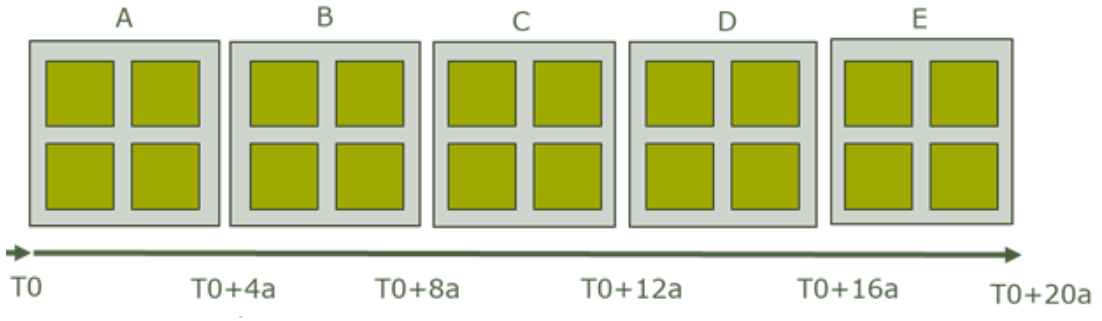
Future waste (dismantling)

11.7 Modules

Characterisation of the waste required (Gap analysis vs conformity criteria)

Prioritisation of the waste for the 1st tumulus (20 modules)

Existing waste
Future W - Operation
Future W - Dismantling



Waste not considered:

- Future production after operation of the 1st tumulus
- ASR drums "gelvaten" currently non-conforming waste
- Resins & Bitumen: currently not covered by safety assessment
- Historical waste: lack of data (characterisation)
- Ashes: high activity/sulfates/chlorides content

1600 L drum

Waste Considered:

- Compacted & Non compacted Waste
- Filters & Varia
- Resins & Concentrates
- Dismantling Waste

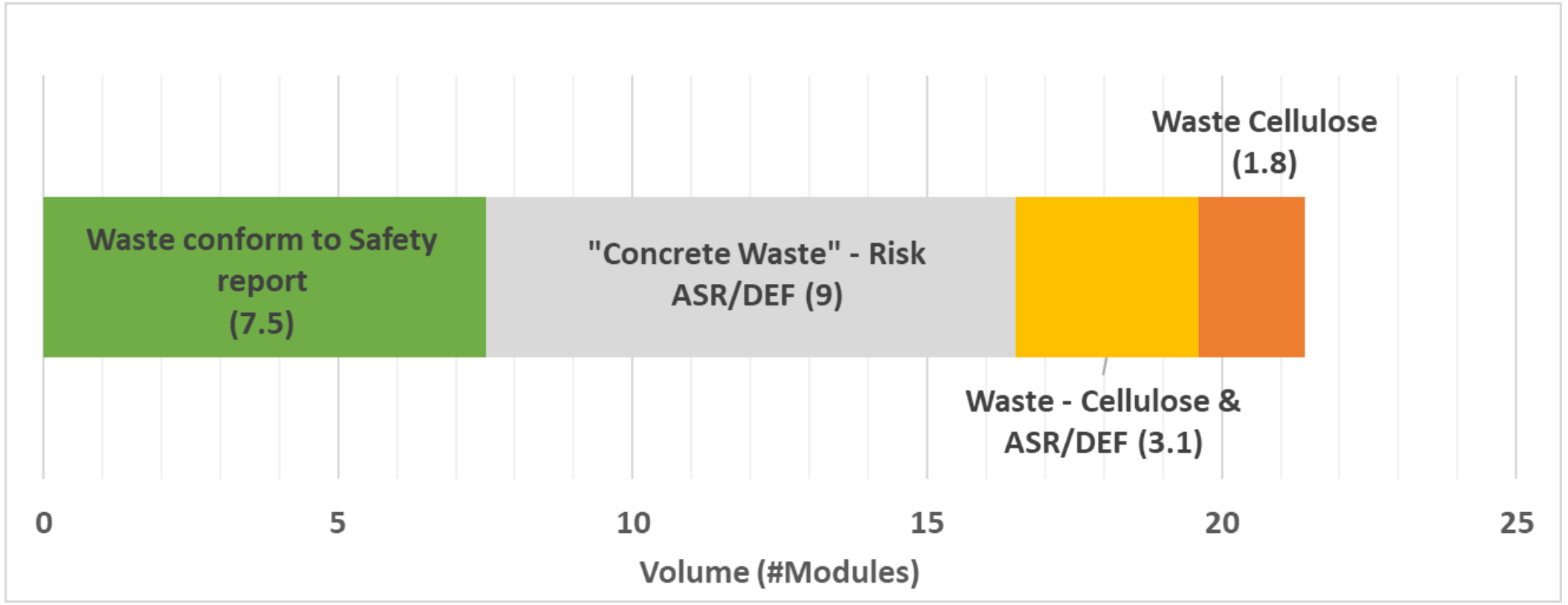
CILVA 400L drum

➔ Volume of waste : 21 Modules

Waste for the 1st tumulus ASR/DEF = Top priority

Existing waste
Future W - Operation
Future W - Dismantling

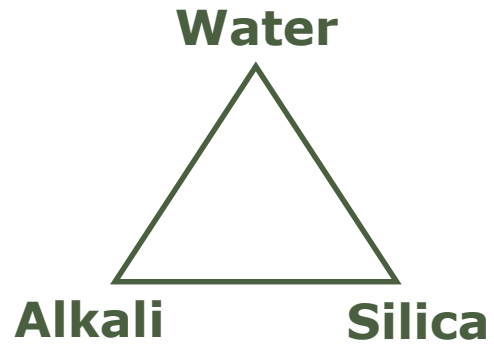
- Evaluation of the physico-chemical characterisation of the waste



ASR/DEF are processes that that can lead to expansion ➔ to be avoided

- Two processes identified for cement materials: ASR and DEF
- ASR (Alkali-Silica-Reaction)
  - Swelling reaction that occurs over time in concrete between **highly alkaline cement paste** and the **silica** (aggregates, sand) in presence of **water**

Risk observed for Homogeneous cementation of concentrates (gelvaten)



- DEF (Delayed Ettringite Formation)
  - Ettringite is a normal product of early cement hydration
  - If high early temperature in the concrete occurs ➔ prevents the formation of ettringite
  - A delayed formation could occur and create expansion and cracking of concrete

➔ Conformity criterium: concrete waste must be insensitive to ASR and DEF to be demonstrated through appropriate tests (~1 – 2 a)

Existing waste
Future W - Operation
Future W - Dismantling

Degradation product of cellulose can lead to complexation & increase radiological impact

- Avoid, sort and incinerate
- If not possible, limitation to:

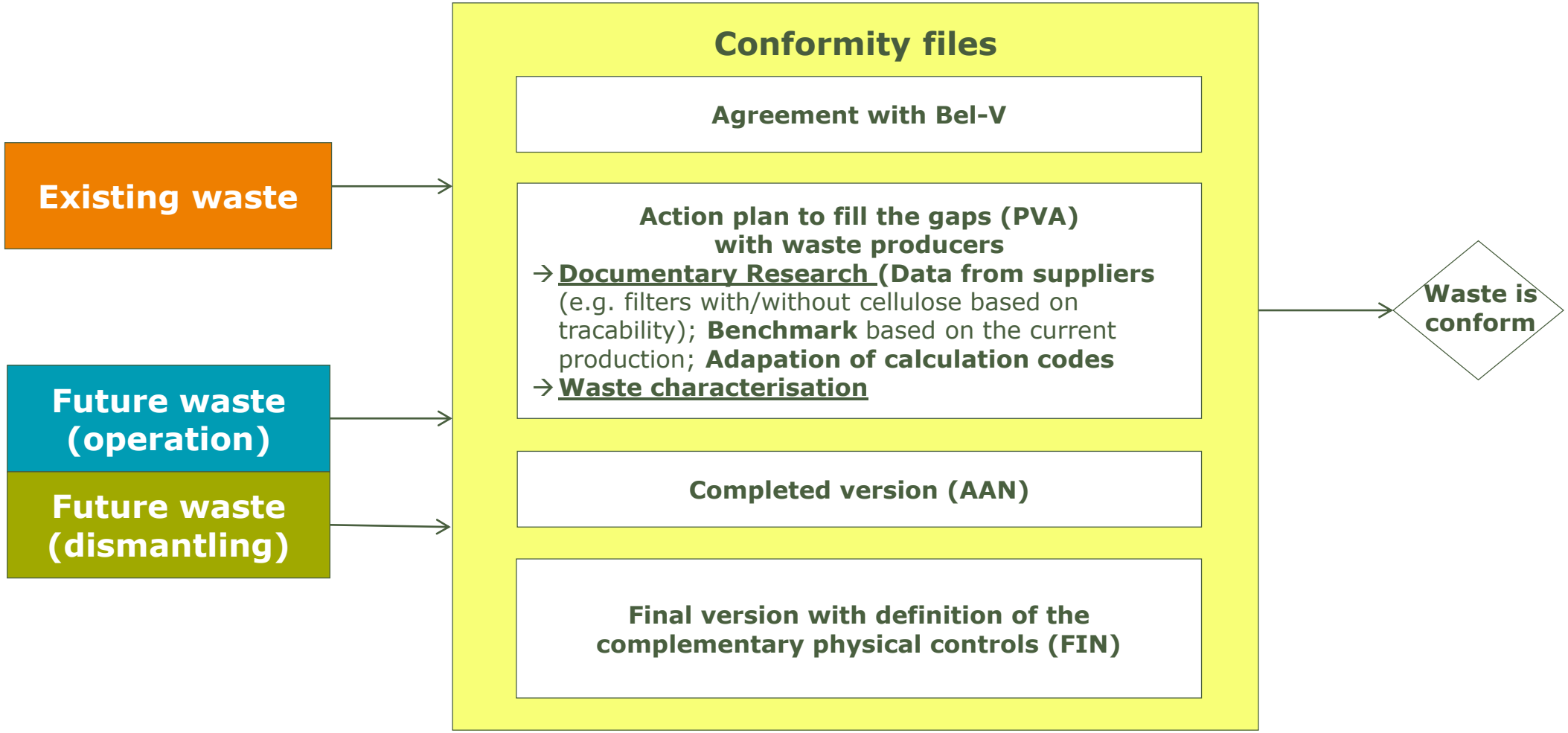
Conformity criterium

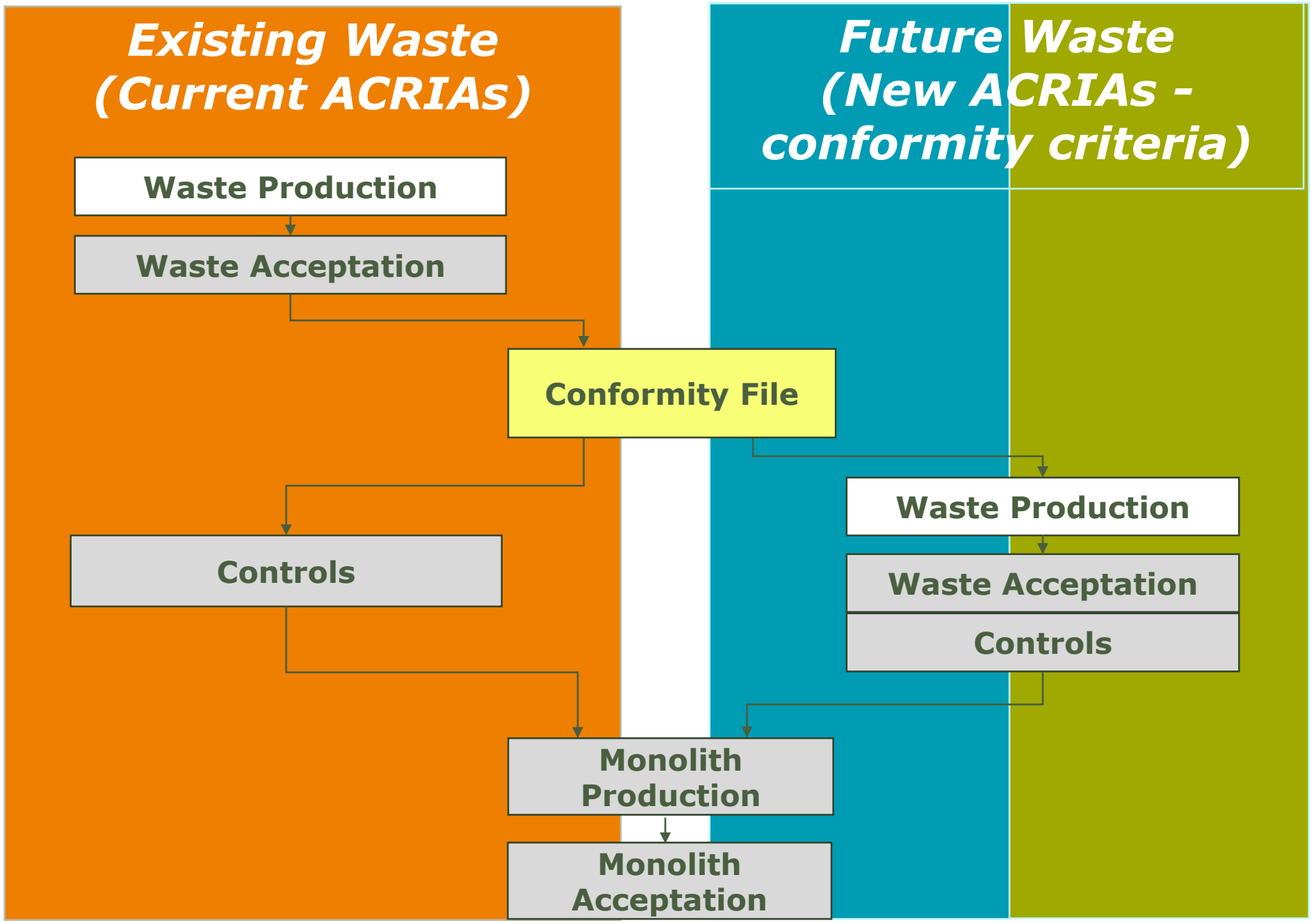
- **≤0.4 kg cellulose / Monolith III**
- **≤0.1 kg cellulose / 400L**

Existing waste

- Cellulose allowed up to **10 – 20 kg / 400L** (if declared)
- For non-conditioned waste, no info required if **M < 0.5 kg**
  3-5 compacted drums / 400L
  ➔ **Risk: 1.5 – 2.5 kg in a 400L**

Conformity files aim to check the conformity of the waste with the disposal




Existing Waste (Current ACRIAs)
Future Waste (New ACRIAs - conformity criteria)
Conformity files
Waste Production
Waste Acceptation
Conformity File
Controls
Waste Production
Waste Acceptation
Controls
Monolith Production
Monolith Acceptation
1) Conformity file produced before waste production
2) Reinforcement of the controls at the "source"

Define specific measures

Modification of parameters / models

Objective: Reduction of the level of conservatism/uncertainty ➔ new scientific knowledge (e.g. R&D on sorption values)

Modification of the EBS

Objective: Make the waste compatible with the disposal system by adapting the EBS - Engineered Barrier System (e.g. compressible materials, fiber reinforced concrete)

Modification of the waste

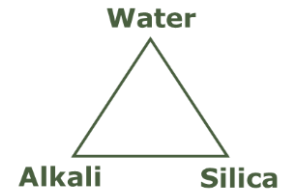
Objective: Make the waste compatible with the disposal system by adpating the waste (e.g. Thermal treatment of the waste)

Define specific measures

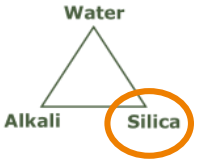
Approach for ASR/DEF

- Criterium: avoid expansion ➔ "insensitive" ASR/DEF
- Modification (more pragmatic / industrial) (e.g. ASR)

Appropriate tests



Reactivity of the aggregates (certificates/tests) → *Reactive* → **Quantity of alkali (certificates /tests)** → *Q high* → **Appropriate tests** → *High expansion* → **Sensitive to degradation in case of ASR**

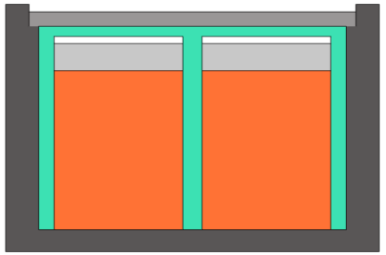


Not reactive

Q limited

Limited expansion

The consequences on the caisson are acceptable by using compressible materials



Insensitive to degradation in case of ASR/DEF

Modification of parameters / models

Expected in 2023

Modification of the EBS

Expected in 2028

Define specific measures

Approach for cellulose

Criterium

0.1 kg/400L
0.4 kg/Mon III

Phase 1

0.2 kg/400L
2.7 kg/Mon III

Review of parameters – (i.e. threshold for impact of ISA)

Expected in 2023

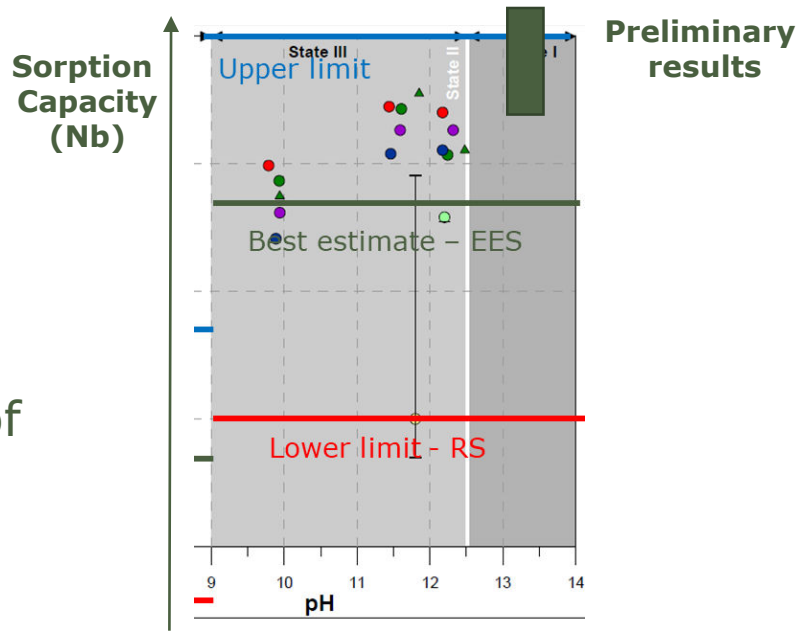
Phase 2

some kg / 400L

Sorption tests (Nb, Pu)

Expected in 2026

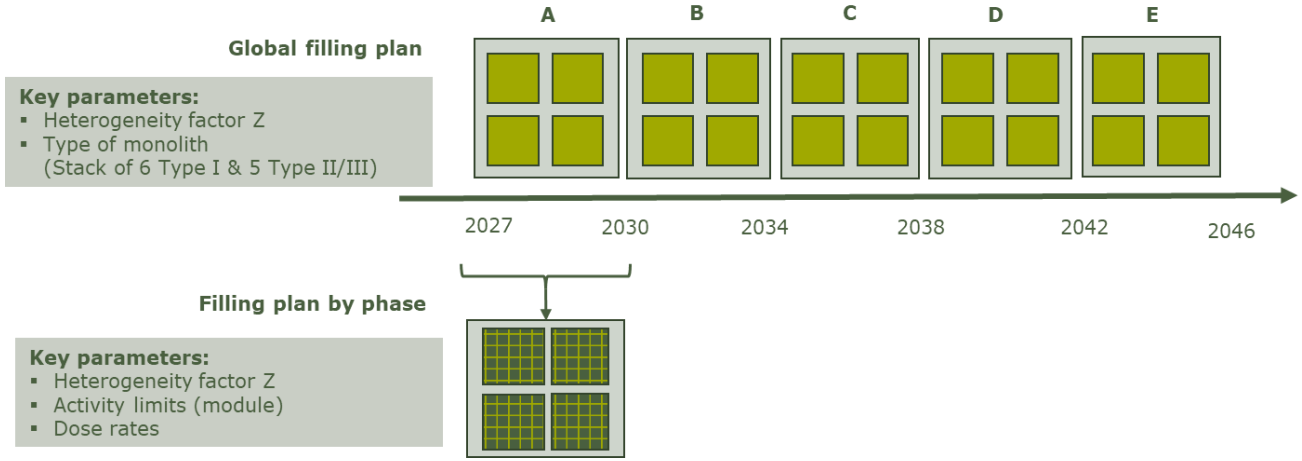
The observed lower limit (literature data) is used in our reference scenario (RS).
The use of representative data for our cement (based on sorption tests) could reduce the level of conservatism/uncertainty



Illustration

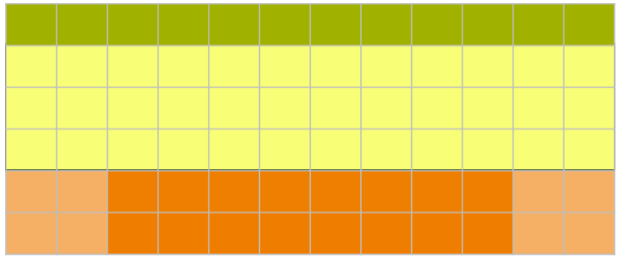
Modification of parameters / models

The filling plan by phase

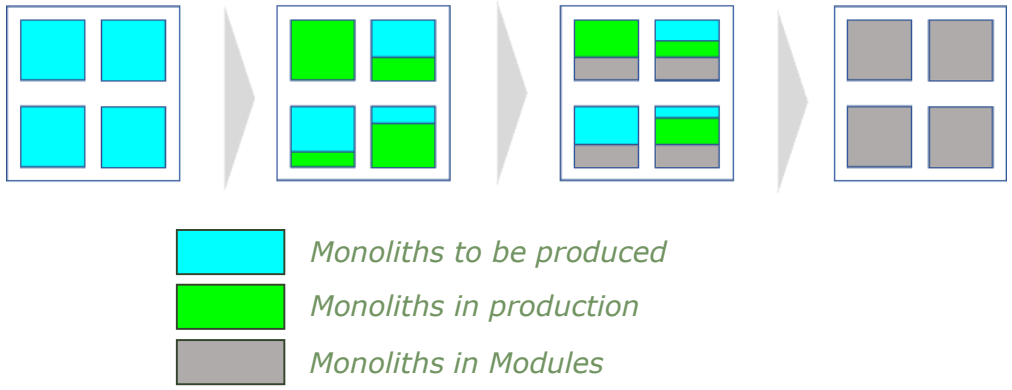


To be further developed

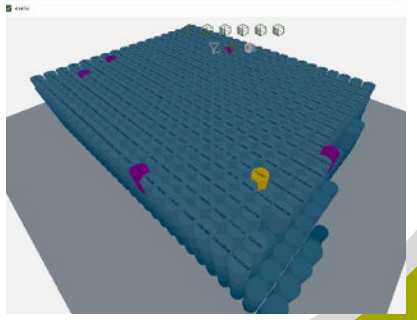
BEFORE OPERATION (MAXIMUM FLEXIBILITY)
Virtual filling of 4 modules in "zones"



DURING OPERATION
- Follow up of key parameters



AFTER OPERATION (TRACABILITY)
Combination of waste packages in monolith & Emplacement of monoliths



Enough waste to fill the first 4 modules (Phase A)

Description	Existing waste	Future Waste
"Conform" Waste	0.7 modules	2.7 modules
"Conform" Waste if new criteria ASR/DEF	1.5 modules	1.3 modules
	2.2 modules	**4.0 modules**

New criteria not respected

Development of a compressible material

More cellulose than expected

Timing & quantity

Modification of the cellulose criteria

More time for operation - phase A

Risks & Uncertainties

Mitigation measures

Confirmation of the conformity of the waste through physical controls

	Standard controls	Complementary controls (DT/NDT)
Frequency	Every Waste Package (WP)	Sample-based
Control	Identification of WP, visual control, surface contamination, mass, dose rate	Relevant conformity criteria (Through conformity file)
Temporary solution	**Manual**	To be develop in **existing installations**
Finale Solution	**Mobile installation**	Development of a **dedicated building** for DT/NDT controls

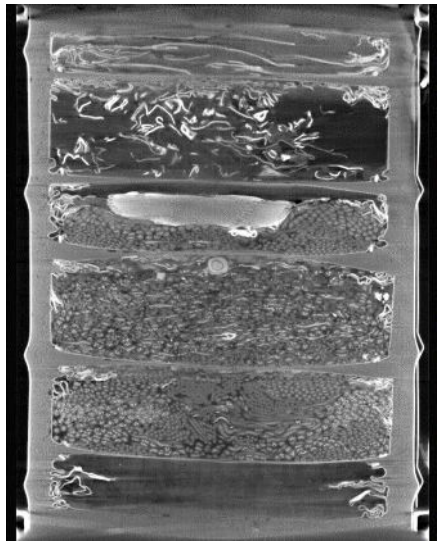
A mix of DT/NDT Techniques

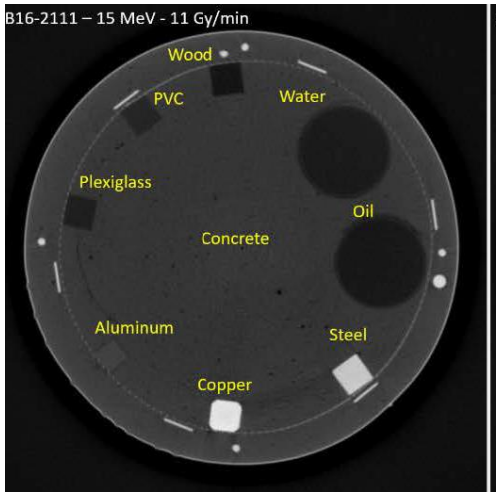
- **Sampling via DT**
- Visual controls (free liquid)
- Measurements in labos
  - Chemical (chloride, sulphate)
  - Radiological
  - Raman spectroscopy (cellulose)…

- **gamma spectrometry**

Temporary solution

- Use of **high-energy photon imaging** to create cross-sectional images (slices) of the waste package
- Visual controls (amount of conditioning mortar, free liquid, …)
- Qualitative assay (density, cracks)





Conclusion: Processes are setting up to ensure the disposability of cat. A waste

- Establishment of conformity files to evaluate the conformity of the existing & future waste
- Definition of specific measures and solutions for non-conforming waste (modification of ASR/DEF & cellulose criteria & dev. of compressible material)
- Development of the filling plan (enough waste to fill the first modules & first tumulus)
- Development of DT/NDT techniques to confirm the disposability of the waste (temporary solutions to be implemented allowing to start IPM)