

## PROJECT DESCRIPTION

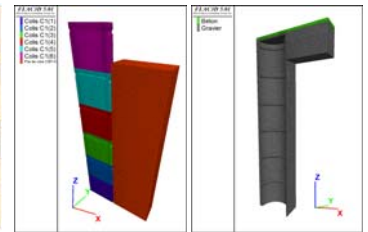
ANDRA (French national radioactive waste management agency)

Aube, France

Andra operates a surface repository in Aube (“CSA”, North-Eastern France), where some of the concrete canisters containing low and intermediate-level short-lived radioactive waste are stacked in concrete structures, then filled with gravel (Fig 1). ITASCA Consultants SAS, together with EGIS Industries, has studied the mechanical behavior of the assemblies, in the framework of design and safety demonstration programs.



**Fig.1 : Vertical section of a cubic canister and gravelled structure containing piles of canisters**

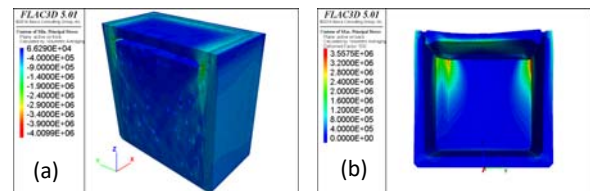


**Fig.2 : Mesh for 2 adjacent piles of cylindrical and cubical canisters, and the surrounding gravel**

## ITASCA'S ROLE

Making use of progressive upscaling (individual canister, then pile of stacked canisters and gravel, and finally assembly of piles) and downscaling (load on piles deduced from stress transferred to homogenised content in structure simulations), the project aims at understanding and quantifying the mechanical behaviour of these assemblies at different scales. It consists in:

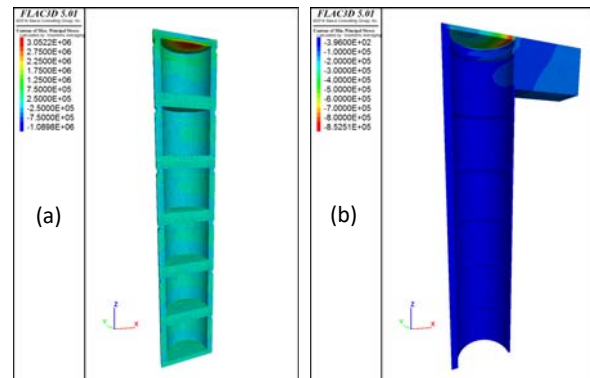
- Phenomenological conceptualisation and definition of the most representative and envelope simulations, considering large variabilities in canister types, and in the distribution of these types in the structure,
- Simulation of individual concrete canisters, taking into account container types and possible defects, as well as waste properties (+40 cases); determination of effective behaviour,
- Simulation of piles of canisters, during stacking and graveling, then under load, considering possible canister eccentricity (30 cases); determination of effective behaviour,
- Simulation of a representative volume for various pile arrangements in the structure; verification of efforts transferred onto piles, and pile re-evaluation under the most critical ones.



**Fig.3 : Minor principal stress in a canister without defect (a); major principal stress (tension) in a canister with defect (b)**

## PROJECT RESULTS

- The mechanical behaviour is evaluated for each constituent:
  - wastes mixture (Fig. 3a),
  - canister concrete elements (Fig. 3, 4a),
  - gravel (Fig. 4b).
- The most critical elements at different scales are identified and evaluated.
- The effective mechanical behaviour of the heterogeneous content of the structure is characterised so that it can be correctly represented in structure design and verification.



**Fig.4 : Major principal stress in concrete containers (a); minor principal stress in backfilling gravel (b) in 2 adjacent piles**