LAND REMEDIATION ON NPP OF BRENNILIS: AN OPTIMIZED APPROACH

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SUMMARY

1. CONTEXT
2. RISK ASSESSMENT
3. AN OPTIMIZED APPROACH
4. CONCLUSION

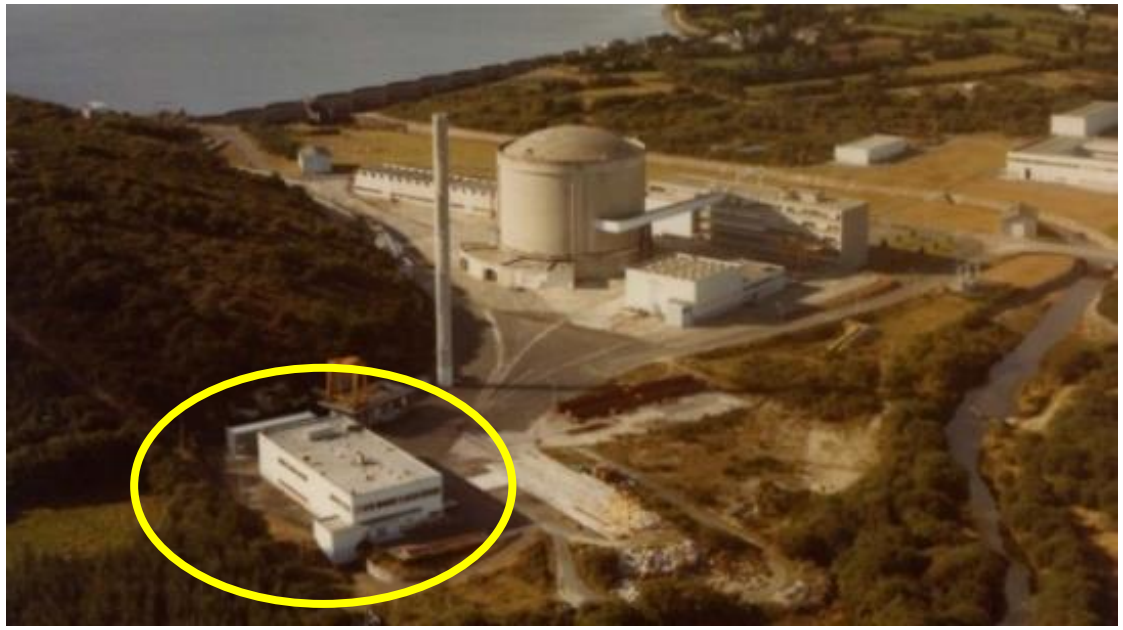
BRENNILIS FACILITY - EFFLUENT TREATMENT FACILITY (STE)

BRENNILIS: a Heavy Water reactor industrial prototype

- Operated from 1967 until 1985.
- Site delicensing: land management strategy required
- Remediation of the former Discharge Channel (2013-2014)

STE: Incidents with effluent drum spills caused contamination of the building platform and underlying soils

- STE walls and platform to be demolished down to the bottom side of the platform
- Contaminated land around the building have been excavated in 2014
- Walls and platform demolition has been achieved in 2018 (1st semester)



GEOLOGY AND HYDROGEOLOGY

STE CONFIGURATION

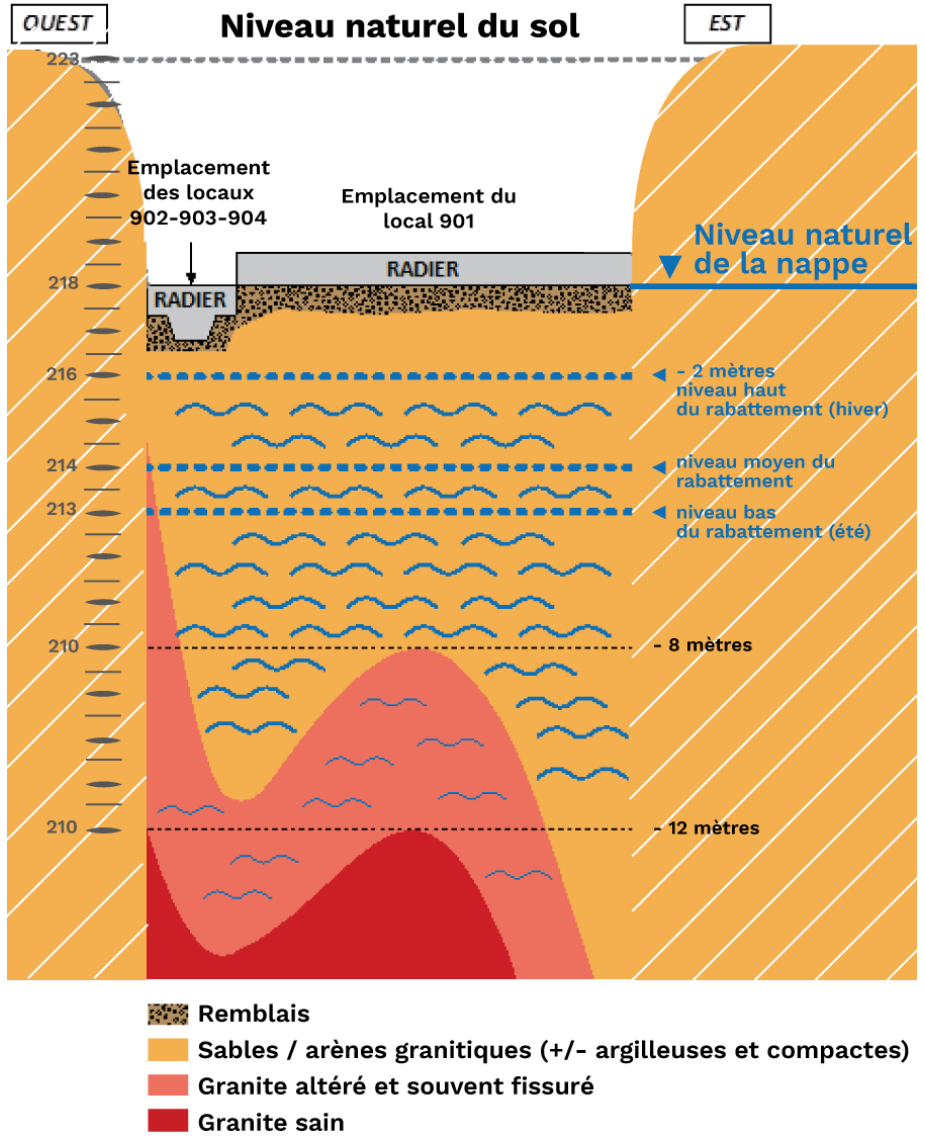
- A concrete platform located at **5m below the natural level** (size: 750 m² / 80 cm width)

GEOLOGY

- Weathered and unweathered granite, with lens of clay
- Different degrees of compaction
- Bedrock at 5/10m depth

HYDROGEOLOGY

- Dewatering wells are operational since 2000 → Prevent structures stability issues
- Watertable is at only 1 or 2m deep and may rise up to the slab

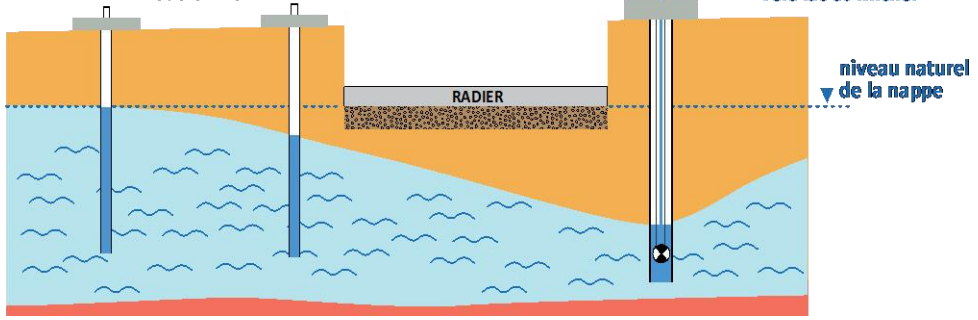


GROUNDWELL MONITORING

THE LOCAL GROUNDWATER QUALITY IS DOUBLE-CHECKED

- Monitoring of pumped water quality from dewatering wells
- Monitoring of groundwater quality from wells surrounding the STE
  - ➢ Almost 10 000 samples – weekly and monthly frequencies - have been analysed (since 2000).
  - ➢ The analytical program includes measurement of physical parameters, chemical and radiological substances

Chemical and Radiological Quality of the Groundwater



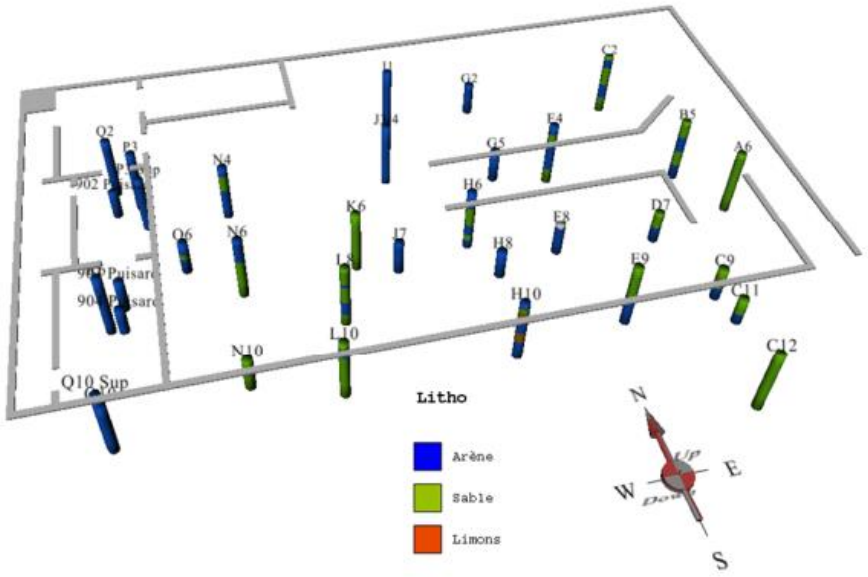
CHARACTERISATION (2008-2009)

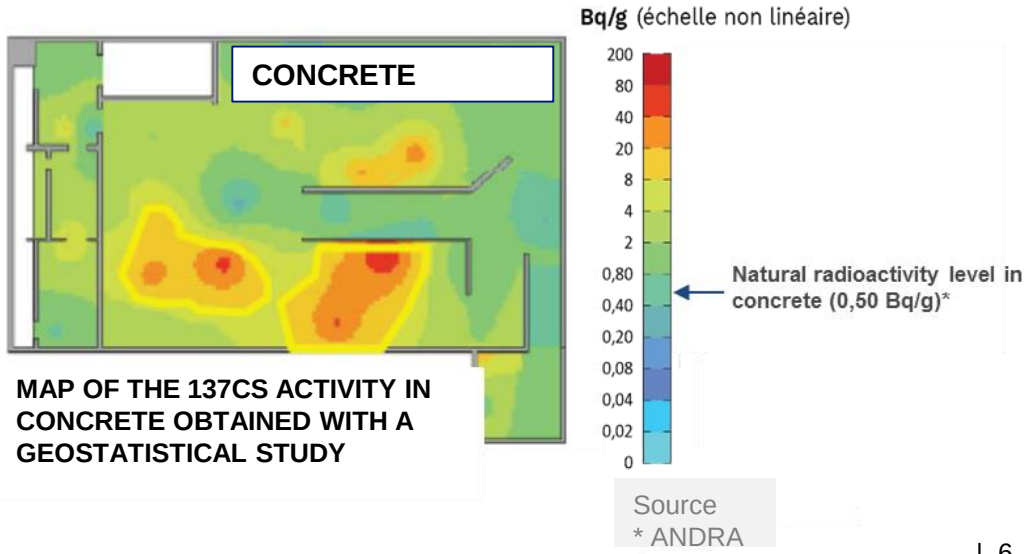
1999-2004: upper levels of the building have been cleaned up and demolished

2008: soil and concrete characterisation campaign using TruPro® Technology

+ 34 classic boreholes, 180 samples, 98 analyses →map of contamination (geostatistical approach)

Two areas with higher levels of contamination → Concrete platform will be removed





MAP OF THE 137CS ACTIVITY IN CONCRETE OBTAINED WITH A GEOSTATISTICAL STUDY

Source
* ANDRA

MAIN RESULTS AND GEOSTATISTICAL STUDY

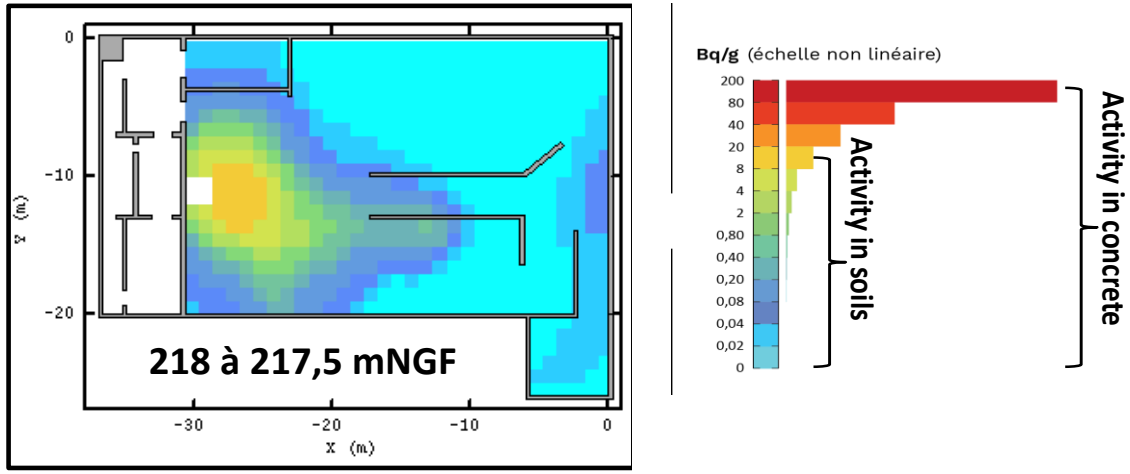
MAIN SOIL ANALYSES RESULTS:

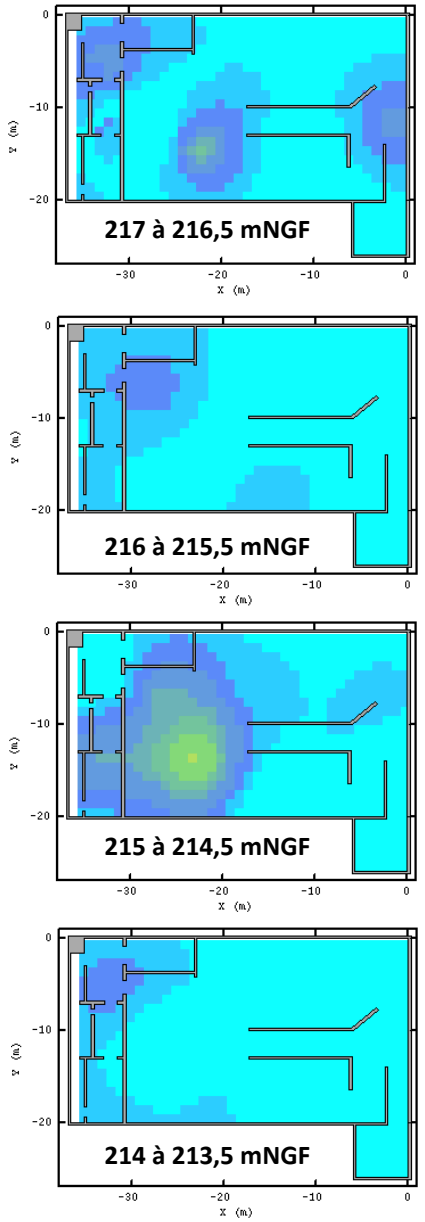
- Field analyses: **<10 % of the samples** showing an higher dose rate than the natural background.
- Lab analyses: ^{137}Cs median (tracer) = 0,026 Bq/g.

GEOSTATISTICAL STUDIES ON SOILS DATA:

Low and diffused contamination of the soils.

Radiological activity mainly located in the upper layer (0-50cm).





MAP OF THE 137CS ACTIVITY IN SOILS OBTAINED WITH THE GEOSTATISTICAL APPROACH

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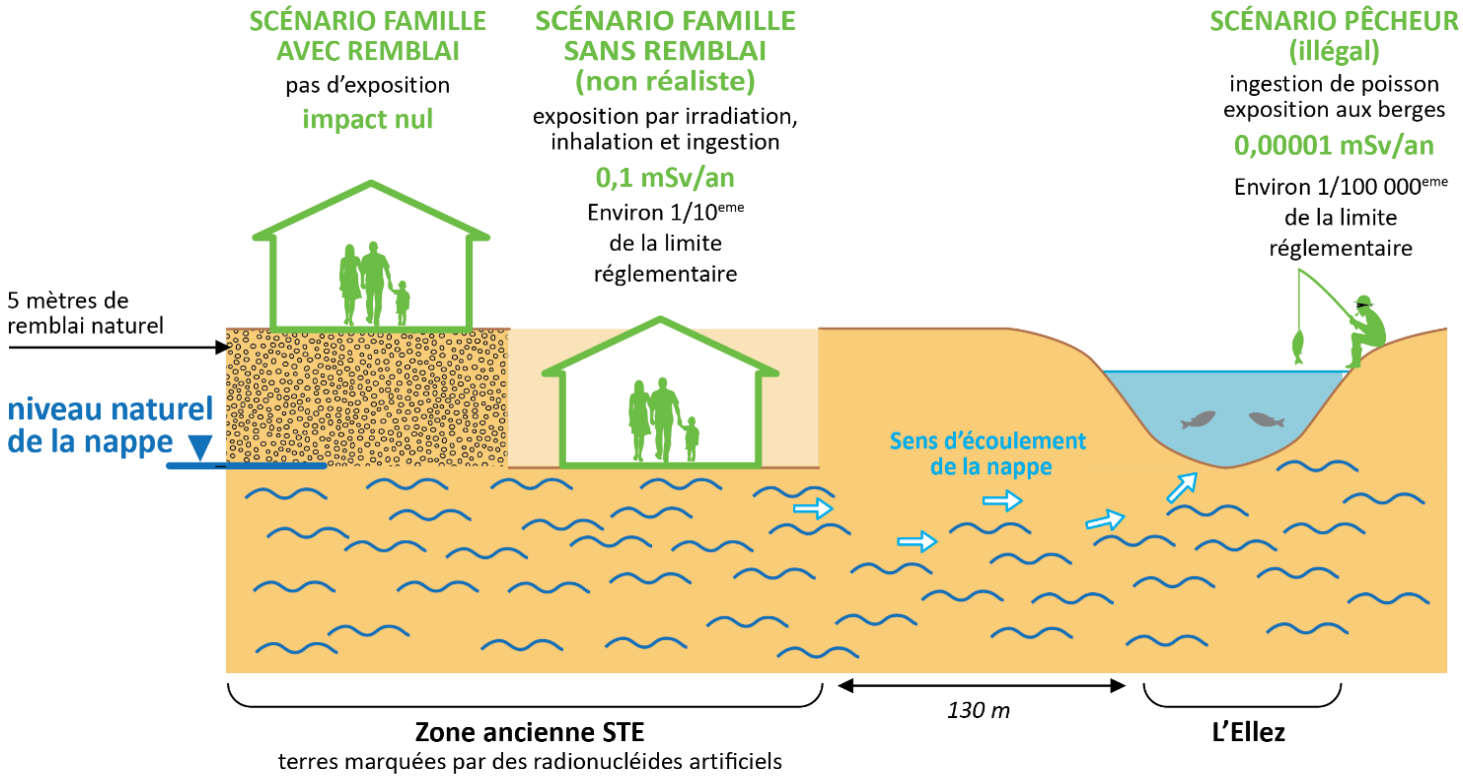
RISK ASSESSMENT BEFORE REMEDIATION

RADIOLOGICAL DOSE ASSESSMENT:

(un)Realistic and Generic exposure scenarios (IRSN, 2011) have been studied: fisherman, offices, garden, residence, etc.

Before soil remediation and with an **upperbound approach** as regard to transfer in the environment, the results show a **low dose level**, from 0 mSv/y to 0,1 mSv/y.



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AN OPTIMIZED APPROACH WITH RESPECT OF ASN GUIDE N°24

- The exposure scenarios conclude to a very low dose level, which should allow to limit the remediation only to the concrete slab removal.
- ASN recommends to go as far as reasonably achievable in the remediation process, when the full removal of artificial contamination is not possible.
- EDF conducted an analysis to reduce furthermore the residual activity in the soils, concluding to propose to remove the upper layer (50cm) of soils underneath the platform
- Optimisation consisted in reducing the source term (and impacts) taking into account technical difficulties (groundwater presence), worker's safety and quantities of Very Low Level Waste produced.

→This management plan has been validated by the French Nuclear Safety Authority (ASN) on April 18, 2018.

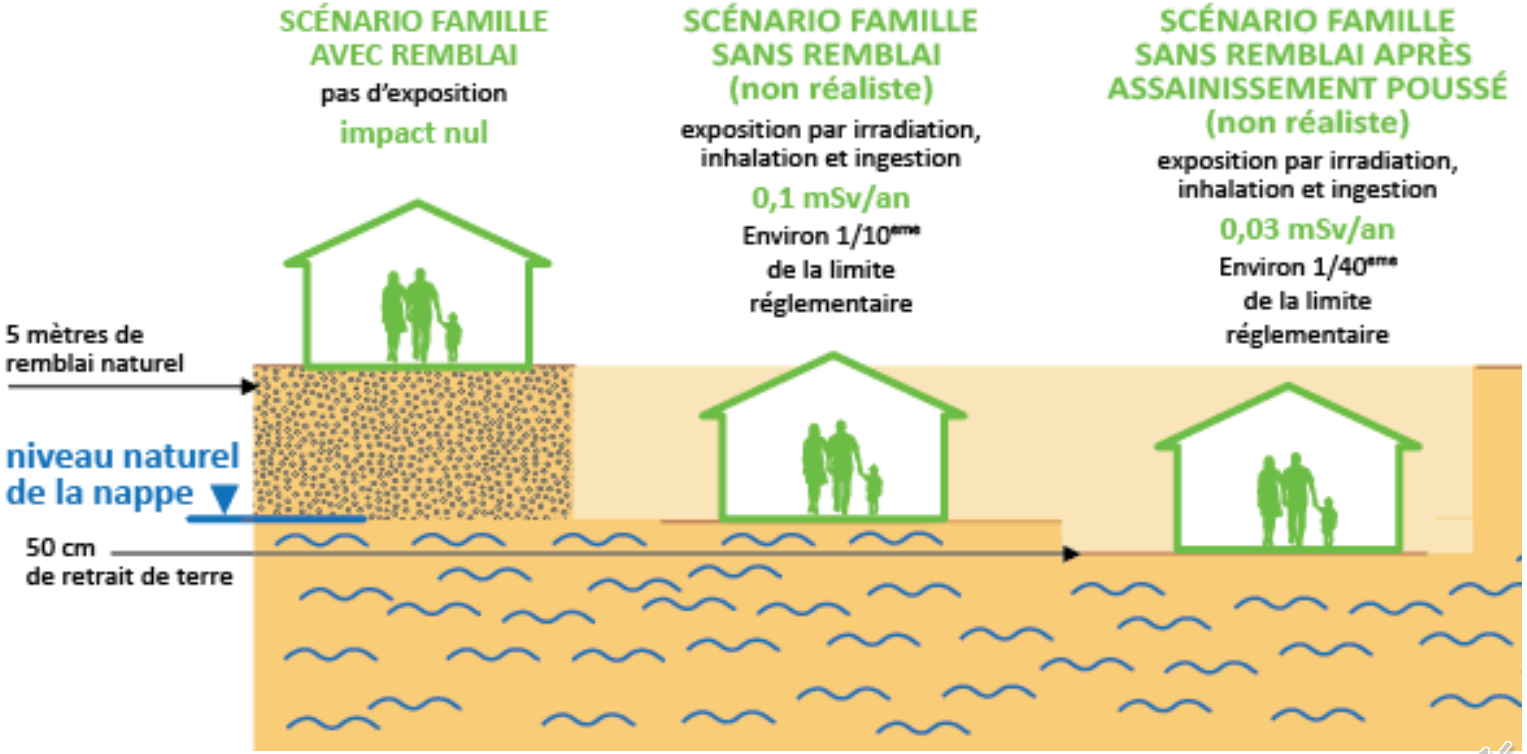
AN OPTIMIZED APPROACH : DOSE REDUCTION

The excavation of the upper layer (50 cm) allows a significant reduction of the residual source term

- Reduces more than 83 % of the initial source term activity (concrete and soils)
- **Reduces by 4** the residual dose for the worst case scenario (family living at the bottom of the pit) considered unrealistic.

Removing more than 50 cm ?

- No reduction of the dose level for all the scenarios.
- Natural groundwater levels would prevent a deeper excavation.



AN OPTIMIZED APPROACH: ENV. IMPACTS

OPTIMIZED WASTE PRODUCTION (VLLW):

- It allows a sensible use of the rare resource of nuclear waste storage according to French national policy objectives (PNGMDR)

Optimized excavation → Carrying out excavation operations

	Soil excavation justified by the protection of interests	Planned excavation (first 50 cm)	Made excavation (~ first 80 cm)	Remote of 100% of the source term
Rounded volume of soil waste (tonnes)	**0**	**1 090**	**1 140**	**> 32 000**
% source term remote (concrete platform + soil)	**80%**	**85%**	**85%**	**100%**
Residual impact - µSv/an (Fisherman scenario)	**0,008**	**0,006**	**0,006**	**0**

80% of the source term is in the concrete platform

WORK IMPLEMENTATION: NO RISING GROUNDWATER

Workers safety: classic conditions during excavation

Duration: 2 months

The excavation of the upper layer allows the best efficiency between the source term reduction, the means employed and the environmental impacts

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CONCLUSION

The management plan realized by EDF:

- Demonstrates **compliance** between the land and **all foreseeable uses**
- Respects the recommendations from Guide N°24 of ASN and PNGMDR
- Shows that an **excavation** of the upper layer of soils (1 000 m^3) **reduces by 4** the residual dose in the worst case scenario (family living at the bottom of the pit) considered unrealistic
- Leads to an **optimized remediation** by reducing both environmental effects and waste production.

After the remediation, the pit will be filled up to the natural level and the objective is to stop dewatering (under ASN validation). EDF will ensure an environmental monitoring including groundwater.

This feedback shows that:

- Very Low Level waste volumes grow exponentially with lower remediation targets
- The development of multi-criteria approaches (implementation of cost-benefit balances in management plans for marked lands) facilitates the search for the best compromise

THANK YOU FOR YOUR ATTENTION