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Clearance practices applied within Thetis & BR3 decommissioning projects

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To clear or not to clear, BVS-ABR, September 11th, 2015, Brussels

Clearance practices applied within Thetis & BR3 decommissioning projects

- Thetis & BR3: similarities & differences
- Clearance of solid materials
- Clearance of the buildings (including recent developments)
- Concluding remarks

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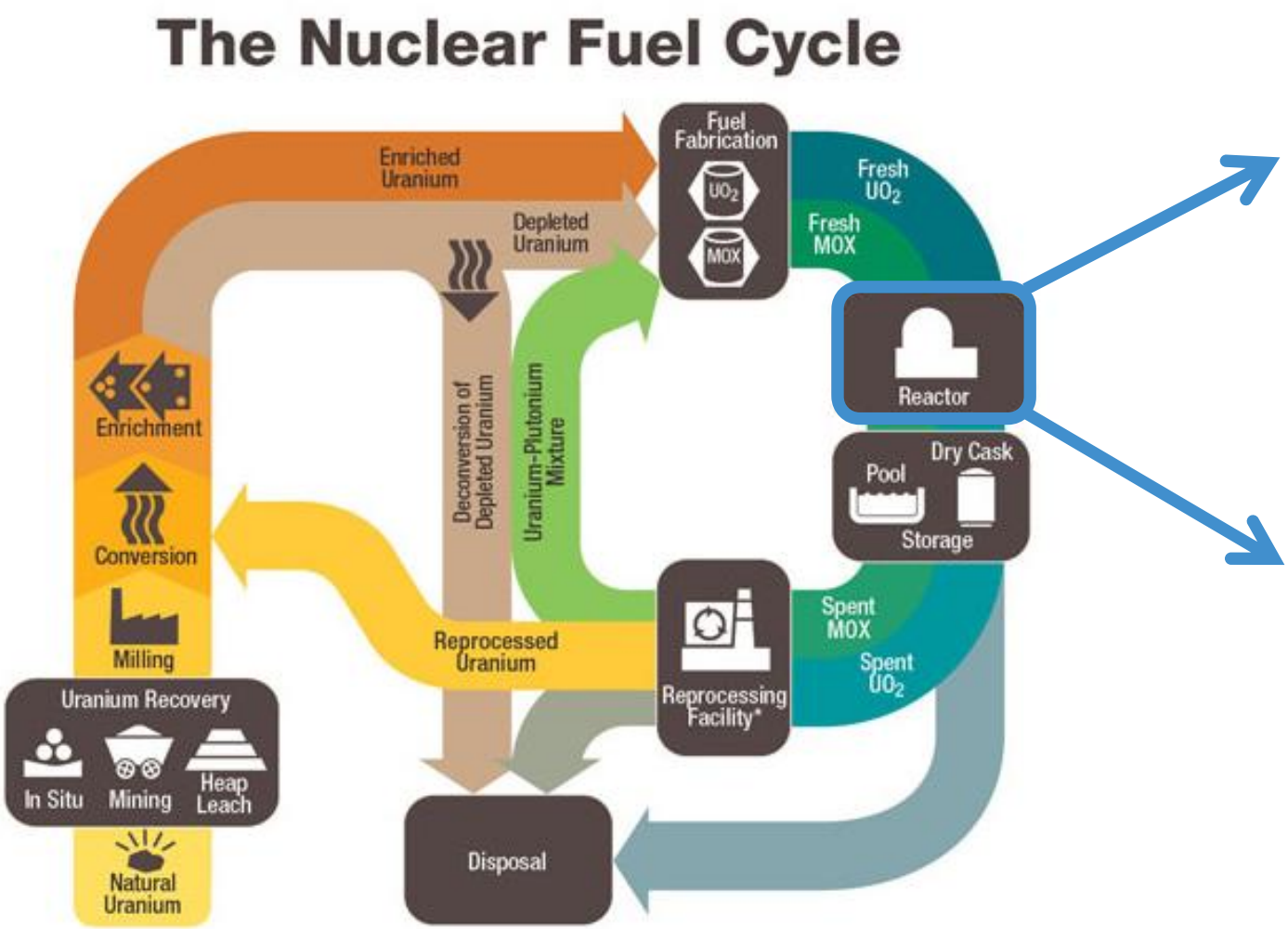
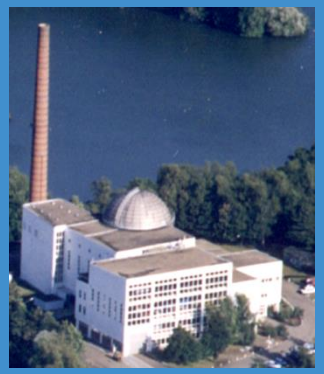
Different facility types might require different strategies
BR3 and Thetis are both reactors



Source: NRC

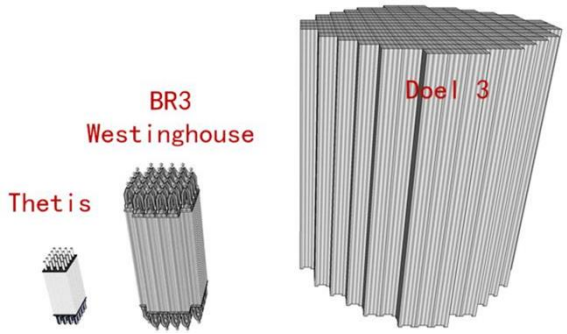
Thetis open pool Research Reactor

Belgian Reactor 3 Pilot PWR



Operational data sheets for Thetis and BR3 differences in operation & size

	Thetis	BR3
Type	Open pool	Pilot PWR
Principle	LEU, light water Graphite moderated	Various fuels (e.g. UO_2, MOX), various moderators, control rods
Power	150 kW (max. 250 kW)	41 MWth (10.5 MWe)
Size pool/reactor	diameter = 3.0 m height = 7.5 m	diameter = 1.4 m height = 5.0 m
Main use	Production of radioisotopes (medical applications) Activation analyses	Demonstration Qualification of fuel elements Training Centre Development of new technologies
Operational period	1967-2003	1962-1987



Clearance practices
Important parameters to take into consideration

	Thetis	BR3
Start of the facility	1967	1962
Type of installation	Open pool RR	Pilot PWR
Total size buildings/installations	Small	Rather small
Main use	Production of radioisotopes Activation analyses	Development of new technologies Electricity production
Important radionuclides	Typical contamination/activation (e.g. Cs-137, Co-60) Typical experiments labs (e.g. H-3)	Typical contamination/activation (e.g. Cs-137, Co-60)
Main process conditions	Aqueous, low temperature, atmospheric pressure	Aqueous, high temperature, high pressure
Radiation protection program during operation Zoning & control measurements	Medium control measurements at room level (bigger laboratory environment)	Limited control measurements at room level (semi industrial scale environment)
Incidents during operation	None (limited)	Medium
Known contaminated areas in the building & hazards	Rather limited	Medium
Examples of levels of contamination	Ion-exchange resins primary loop (Co-60-Mn-54) -> x1000 Highest radiation level installation -> x1000 Highest hotspot building structure -> > x1000	

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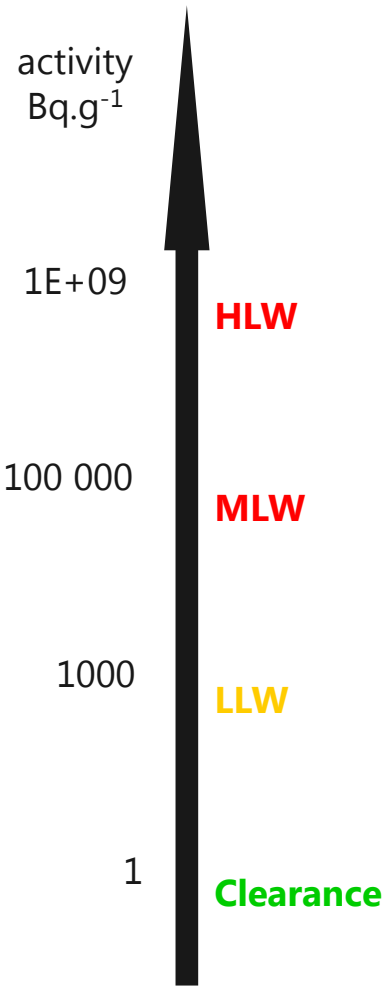
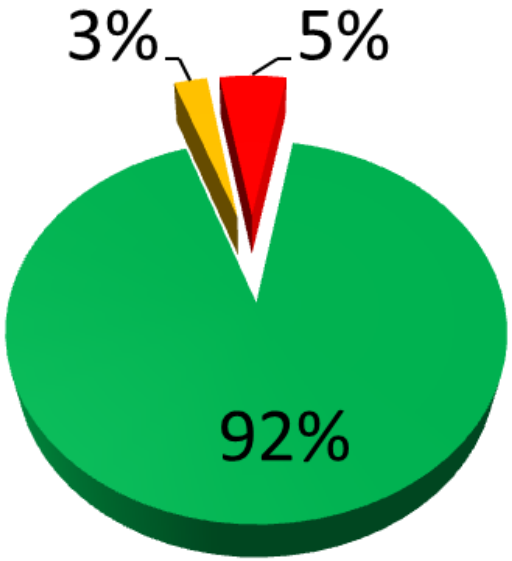
Balances of solid materials removed from site excl. fuel, liquids, building

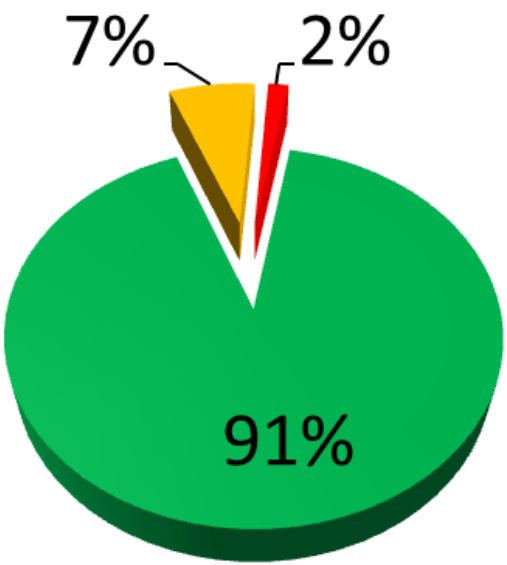


Thetis open pool



total mass >30x

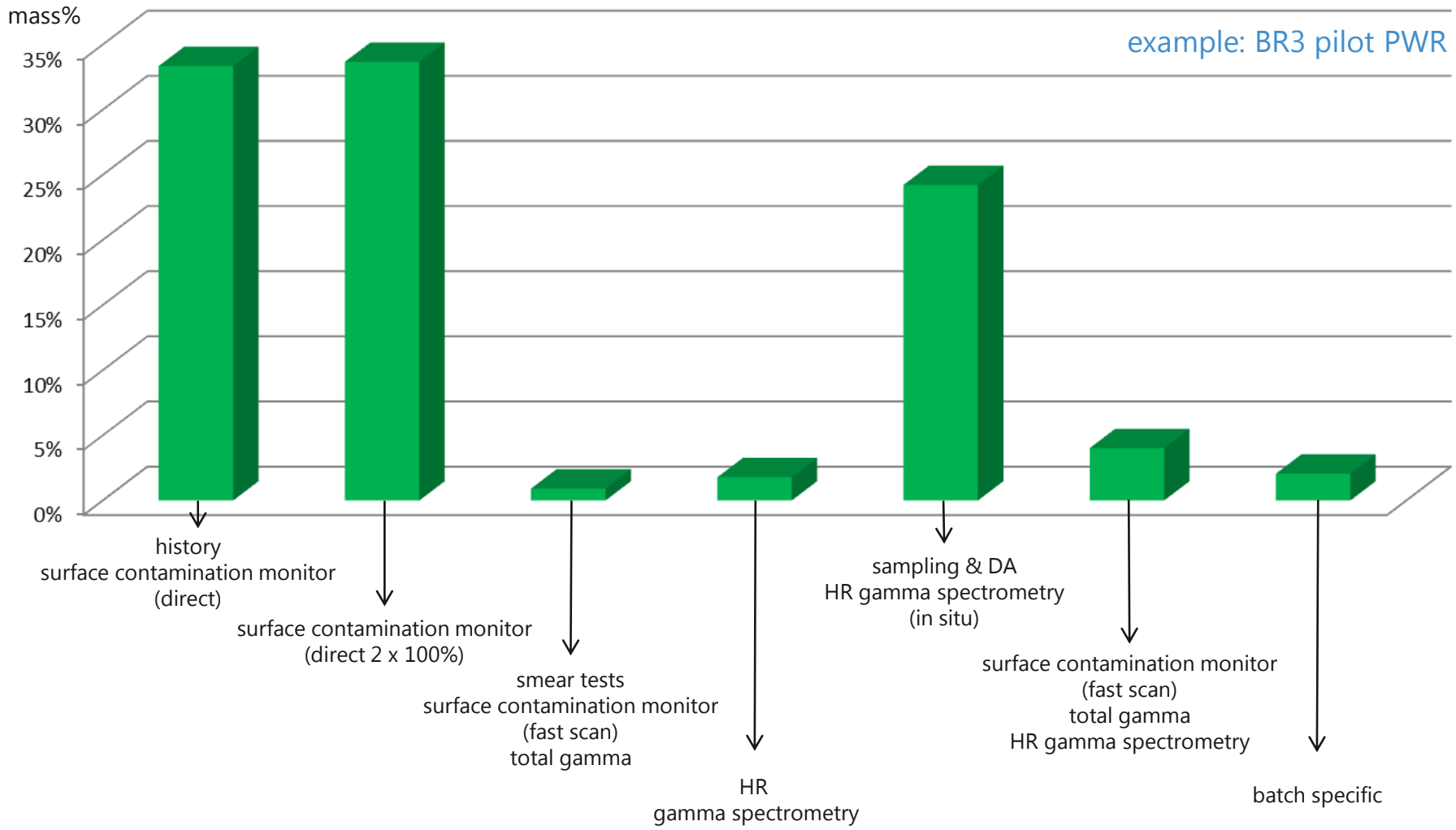
BR3 pilot PWR



Status 2015 – after decommissioning
- Relatively "clean" installation
- No focus on decontamination necessary

Status 2013 – advanced decommissioning
- Medium "clean" installation
- Focus on decontamination necessary

Various release methodologies are being applied
> 2/3 generic & straightforward, but labor intensive



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Building release room & element categorization Thetis & BR3

Thetis open pool

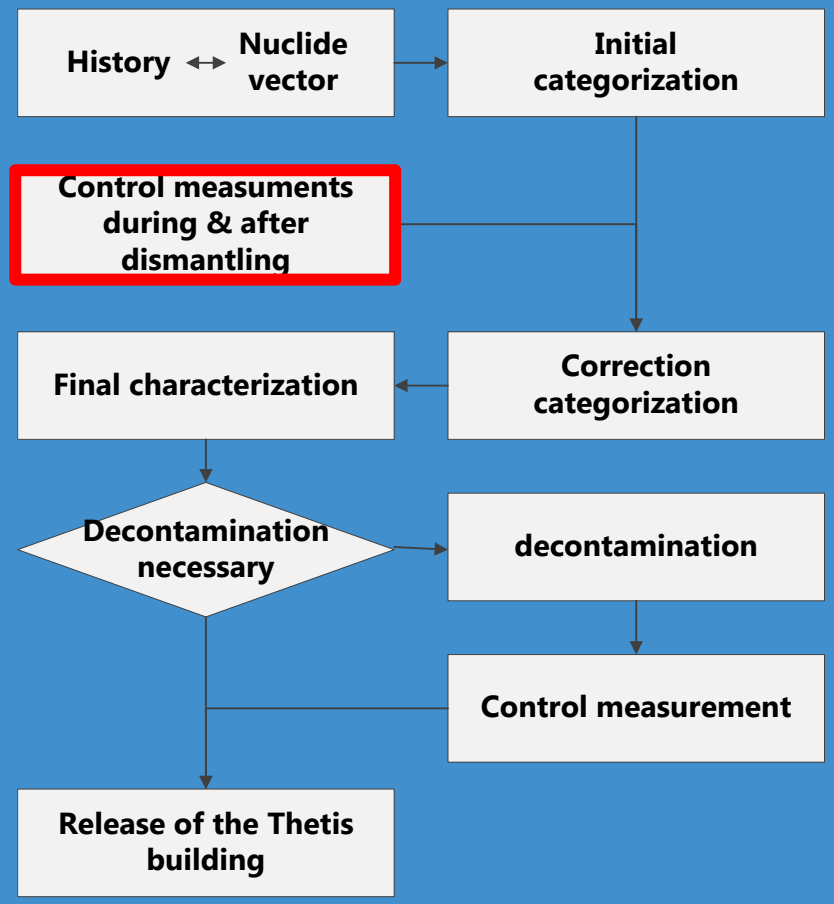
categorie	description
4	contamination = excluded
3	contamination = not likely
2	contamination = possible
1	contamination/activation = present

BR3 pilot PWR

	category	contamination risk	decontamination
0	cold	excluded	not required
1	suspected	aerosols/dust not confirmed	coating removal
2	contaminated	aerosols/dust confirmed no migration	base material removal
3	severely contaminated	liquids possible migration	case by case
4	activated	activation	case by case

Building release working method simplified schemes for Thetis & BR3

Thetis open pool



n° of measurements

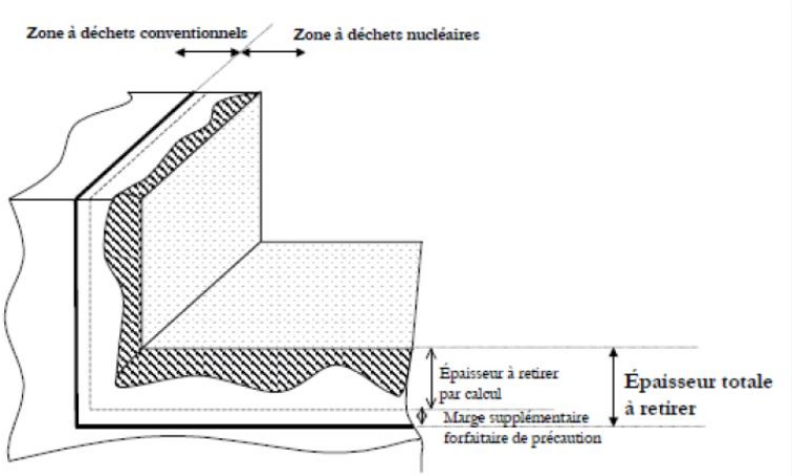
BR3 pilot PWR

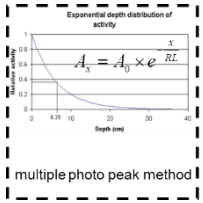
- [1] Inventory
- [2] Preliminary Classification
- [3] Detailed Characterization
- [4] Fine Tuning Classification
- [5] Determination Decontamination Technique
- [6] Decontamination
- [7] Characterization for Clearance
- [8] Denuclearization

n° of measurements

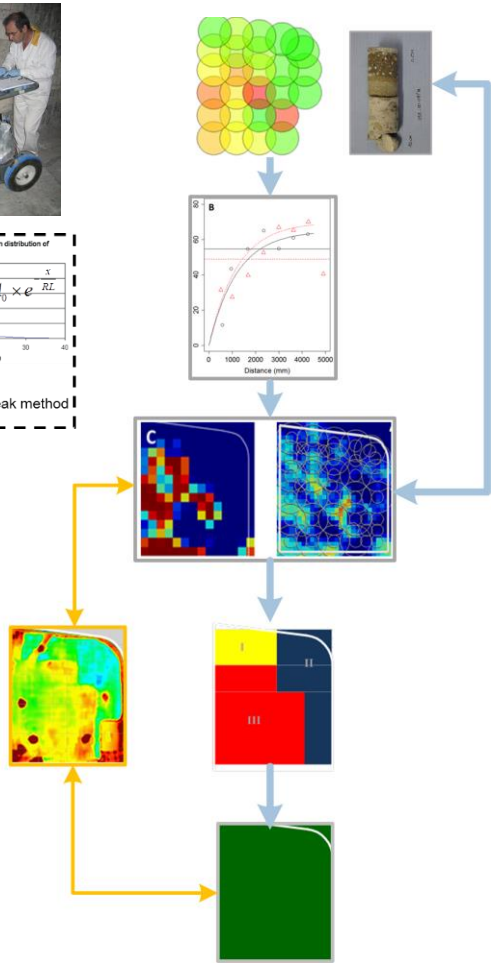
BR3: detailed characterization prior to decontamination contamination depth: development of an NDA method

traditional ⟷ NDA & geostatistical data treatment

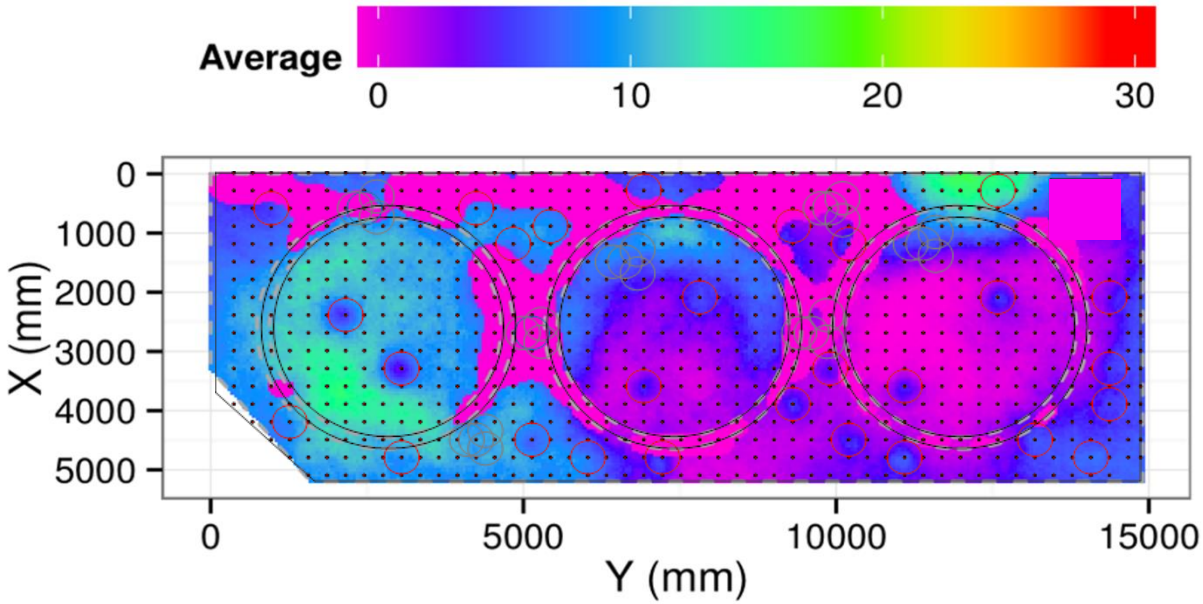




multiple photo peak method



Contamination depth recent developments



- HR-ISGS (HPGe), MR-ISGS (CZT, LaBr3), total beta, dose rate, gamma camera
- Geostatistical data treatment

innovative physics

CMI	CEA	ENEA	IFIN-HH	JRC	LNE	MIKES	NPL	PTB	SCK-CEN	STUK	ANDRA	EDF	ENVINET	Total
63pm	20pm	39pm	32pm	34pm	29pm	22pm	54pm	30pm	10,5pm	12pm	2pm	2pm	24+30pm	403,5pm

The use of in-situ gamma spectroscopy in view of building release

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Clearance practices applied within Thetis & BR3 decommissioning projects

- Similarities in the implementation of clearance practices in different decommissioning projects are existing
- However, the implementation can be very different depending on the installation, size of building & installation, main use, radionuclides involved, main process conditions & hazards (aerosol, aqueous liquids, strong acids/alkaline, radiation protection program during operation, zoning & control measurements, history of incidents, knowledge of the installation/incidents, etc.
- Therefore, harmonization is only possible to some extent
- Development is still ongoing

Thank you for your attention
Questions?

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