Manuela™

Mobile Apparatus for Nuclear Expertise and Localisation Assistance

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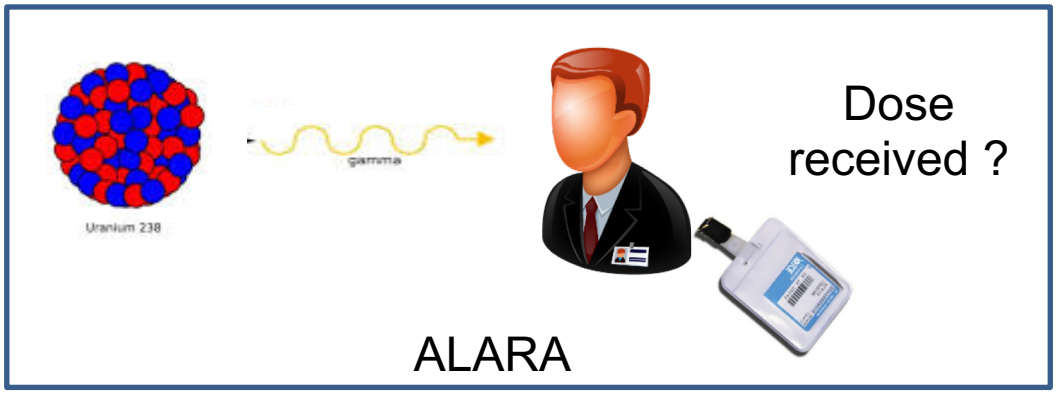
Date

orano

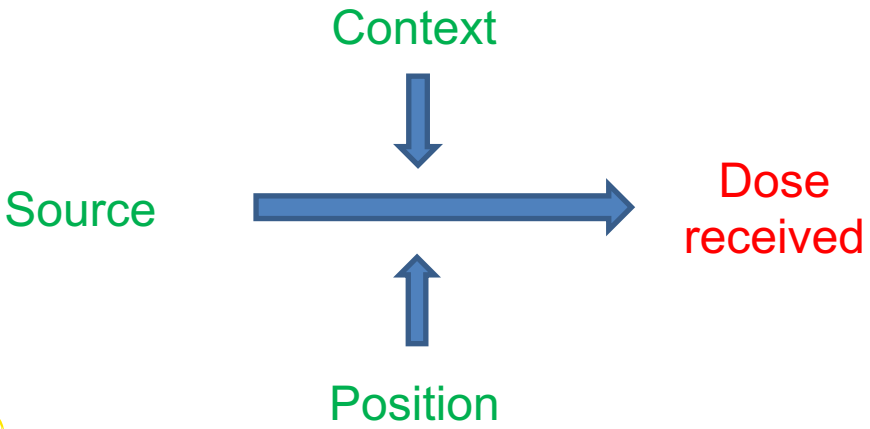
Manuela

Context

A bit of context



Podium showed some issues with dosemeters and asks the question of getting the information differently ?



⇒ Let me modelize your environment

⇒ In this environment, let me modelize your source

⇒ Then let me track the movement of your workers

A bit of context

In medical :

- the source (x-ray machine/patient) is in the intervention room
- the source is well known, or if not, is quite easy to be so.
- Podium shows that tracking is possible.

What about the context in Nuclear Industry ?

Outdoor & indoor

A bit of context

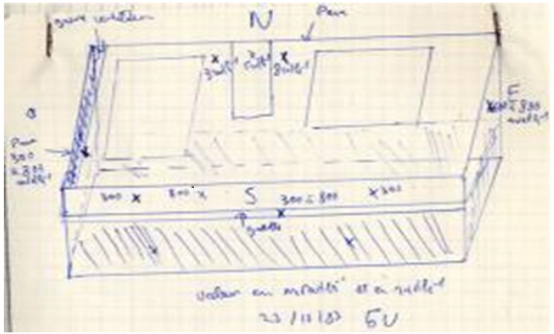
Ok …. And what about source description ?

- Example Alarm & DIMR Cattenom

=> The need for good radiological informations

What about mapping and measurements position ?

Mapping



Position

Dose rate Measured ?

Example: Human factor…

A bit of context

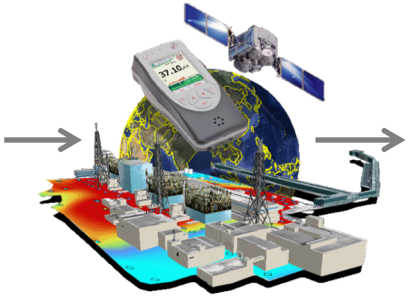
So modelisation is not a good idea ?
It is not only a good idea but it is also « mandatory »

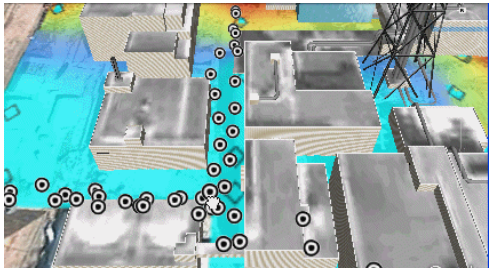
- Exemple of a nearly-accident in Bugey
- Highest safety expectations in nuclear industry
- Price of the waste….

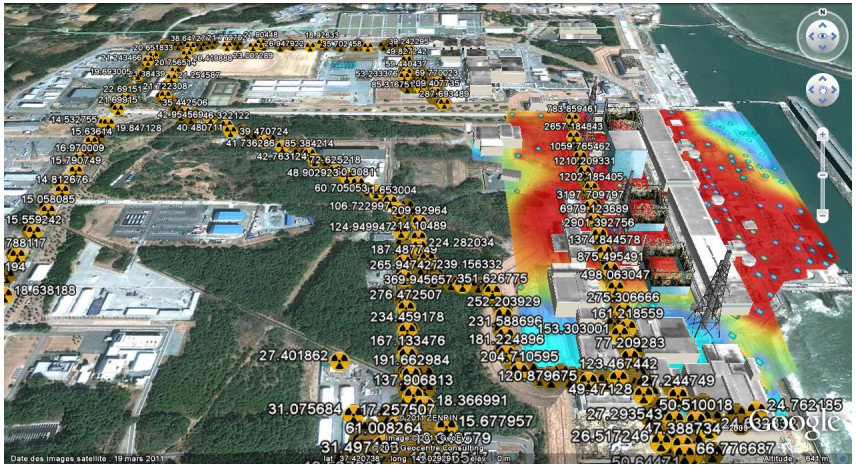
How to solve the problem of input data ?

Outdoor mapping

Fukushima 2011





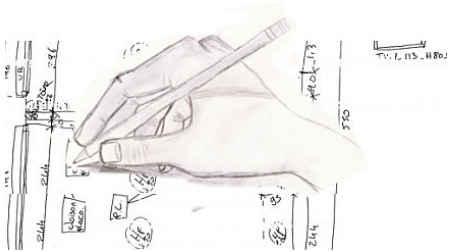


- Old map
- Need for infrastructures
- 4m accuracy

Indoor mapping ?

~~GPS~~.

Environment variations can be fast
(NPP shutdown for fuel reload, historical maps outdated,…)



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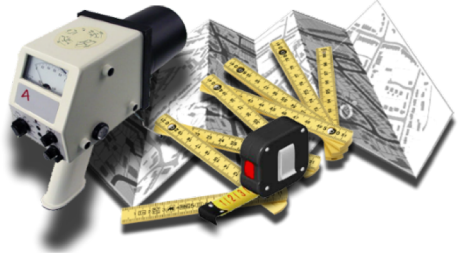


MANUELA:
A tool for radiological and topographical 3D mapping

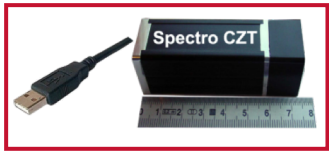
S.L.A.M.

Geiger Müller

Radiological sensor

3D Environment

Dose rate
Gamma spectrometry



Spectrometer CZT

Sc
MANUELA

- *environment*
- *In real time*

MANUELA ?

Manuela

Principle

SLAM Basics

Simultaneous Localization …

Some video flow

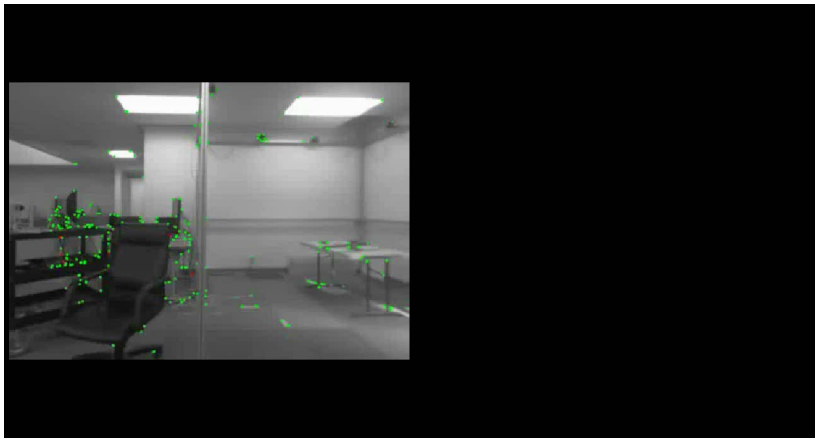
↓

Features tracking

↓

Path building

Odometry: The use of data from motion sensors to estimate change in position over time.



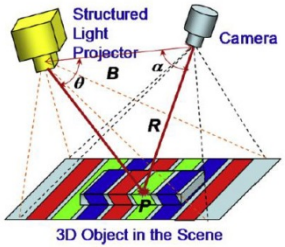
Odometry and topographic instrumentation

… And Mapping

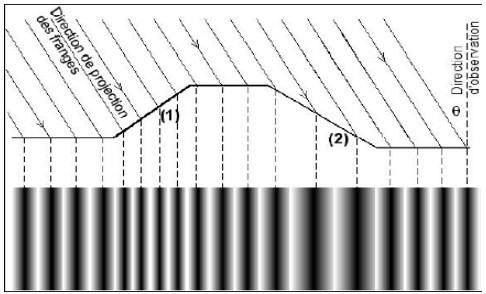
There is differents kinds of camera which allow a 3D mapping (Time of flight, Structured Light, Event, …)

Structured light projector sensor (Kinect 1 of Microsoft)

- **Active stereo: Features projection on the scene to simplify the matching problem**
- **Projected pattern disturbances are linked to depth change at the objet surface.**



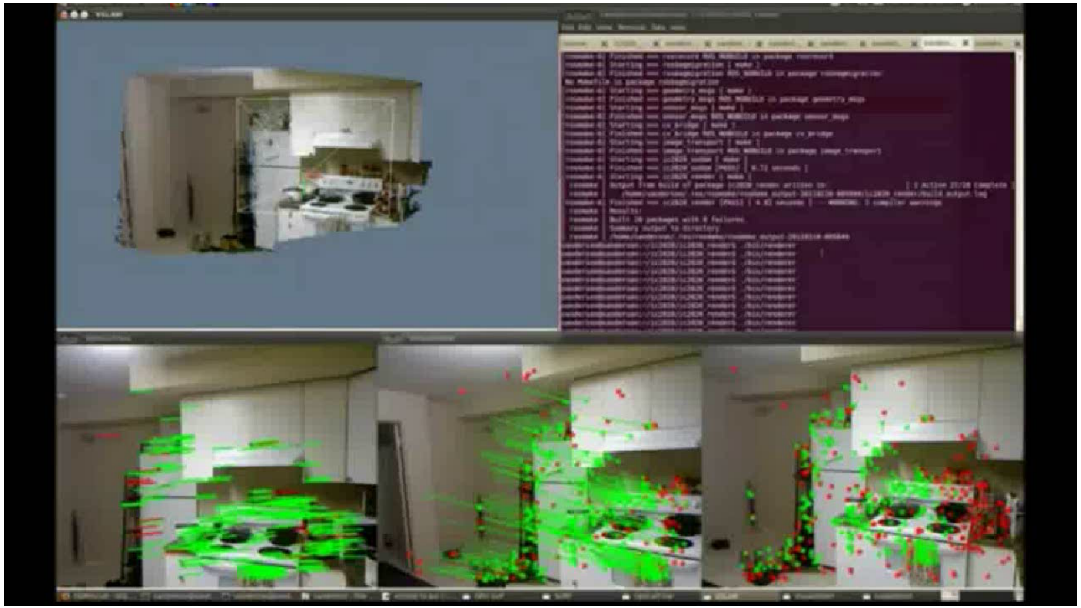
$$R = B\frac{\sin(\theta)}{\sin(\alpha+\theta)}.$$



Half randomly generated framework

Odometry and topographic instrumentation

By mixing the two…



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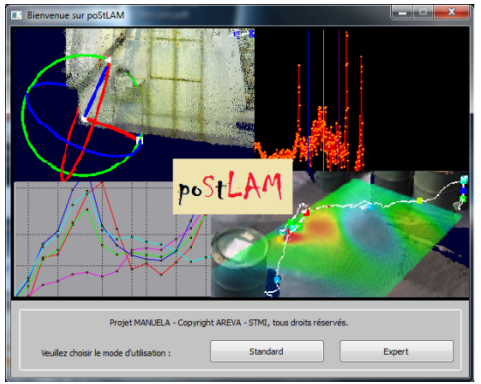
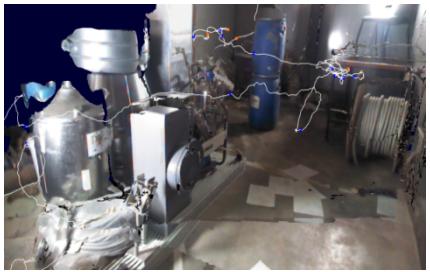
Benefits

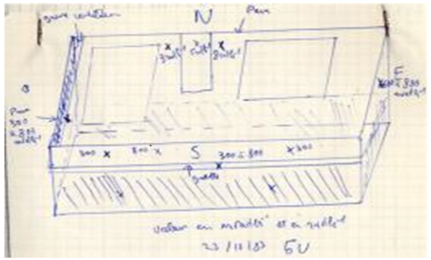


Overview of the MANUELA technology

1 – 3D virtual space

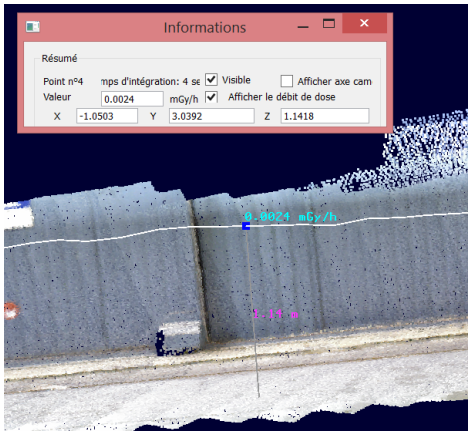


VS



2 – True measurements position

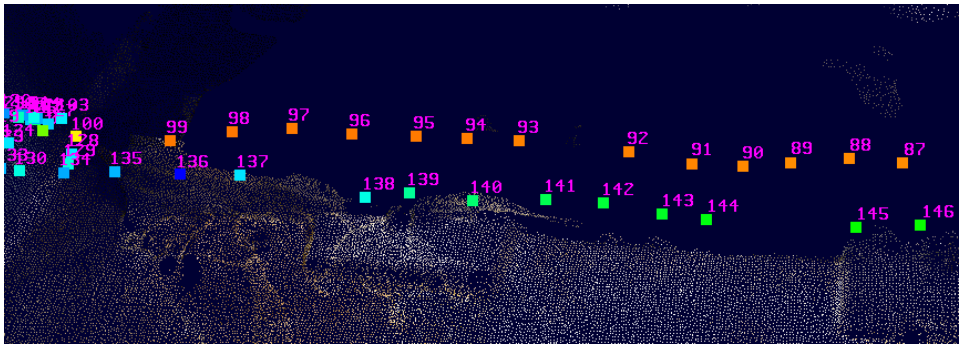
- Measurement position given in a X, Y, Z reference.
- Localisation uncertainties evaluation
- Répétabilité de la mesure possible



Overview of the MANUELA technology

3 – Measurement automatized

- Measurement made each seconds and saved in the virtual space.
- More points → Better caracterization with the same gesture.



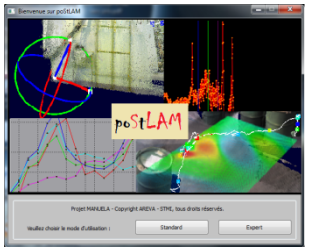
4 – Real time

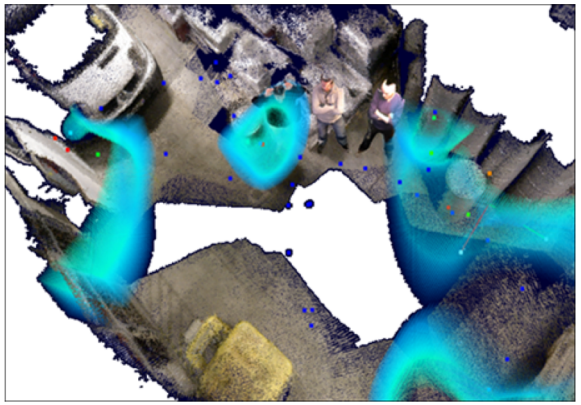
- 3D modeling and hot spot retroprojection available directly at the end of the scan.

Overview of the MANUELA technology

5 – Improved 3D environment

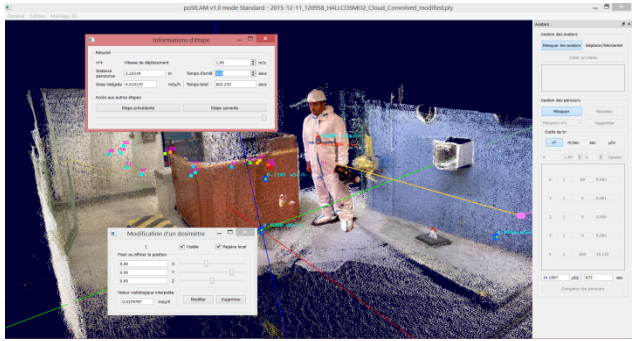
- Better ergonomics
- More tools (isodoses, dimensional grid, …)





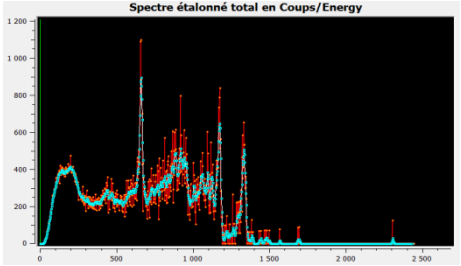
6 – ALARA approach tools

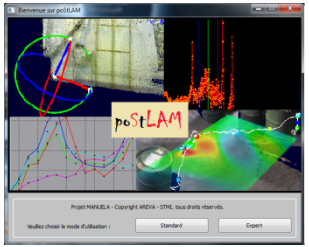
- Avatars with dosimeter on the chest.
- Standalone dosimeters.
- Integrated dose on a route.
- Dose optimization.



Overview of the MANUELA technology

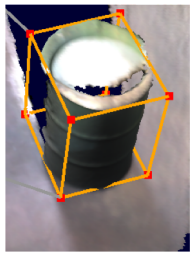
7 – Gamma spectrometry

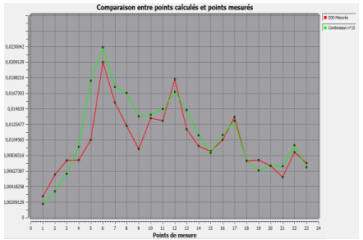


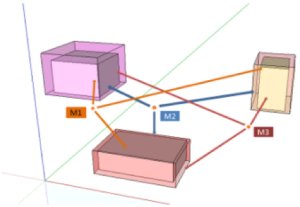


8 – Calculations and simulations

- Activity calculation with transfert function and solver
- Lead protection simulations, removing a source…







Export to different CAD software (tool FRAMATOME : Victoria)

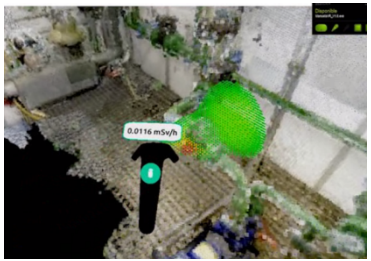
Overview of the MANUELA technology

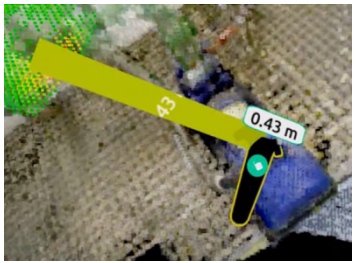
9 – Immersive environment

- Easy deployment
- Visualization of all informations you need without taking any dose

10 – Interactive environment for operator's training

- Virtual dosimeter
- Distance measurements
- Contamination visualization





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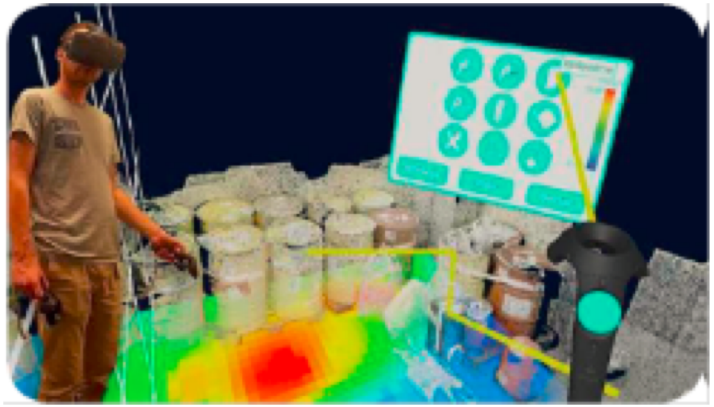
Feedback



Exemples of use

3D mapping

Making 3D mapping in specific area (hall, cells, rooms…) and give a more complete radiological survey including, if asked, spectrometry

Feedback

Fessenheim NPP: EDF

- Intervention in tight environment
- Validation of point of interest
- Orange zone signs verification

Cattenom NPP: framatome

- Steam Generator N-2 Investigation, entry data

BENEF | ENTRY DATA CONTROL | EVENTS O.Z. | COMMUNICATION | PERFORMANCE | QUALITy

3D MAPPING: Fessenheim

20 rooms 3D mapping of the RB n°2 – Fessenheim NPP

QUALITY

More points

Automatic save

Traceability

COMMUNICATION

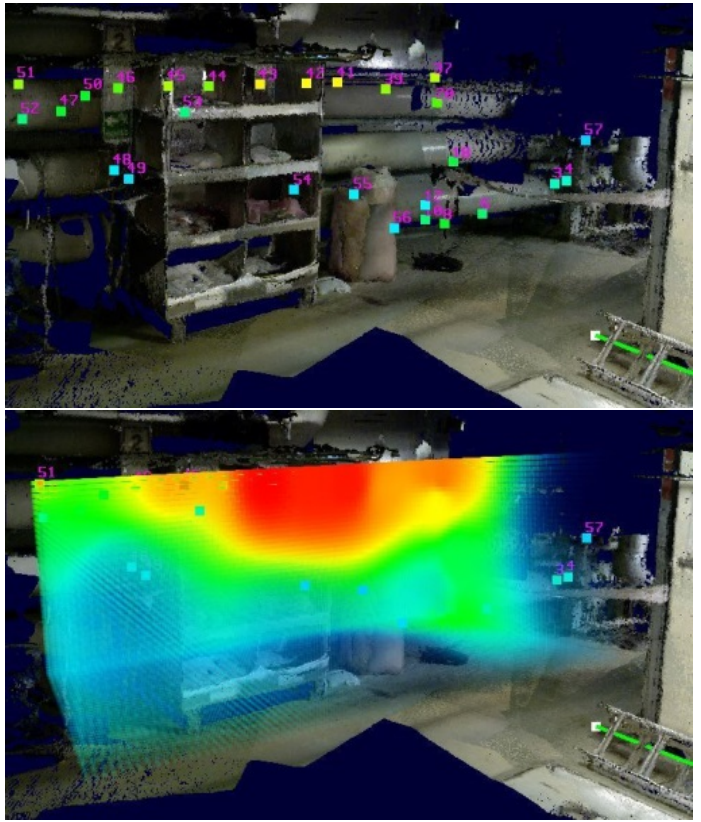
Validation of risks and point of interest

ENTRY DATA CONTROL

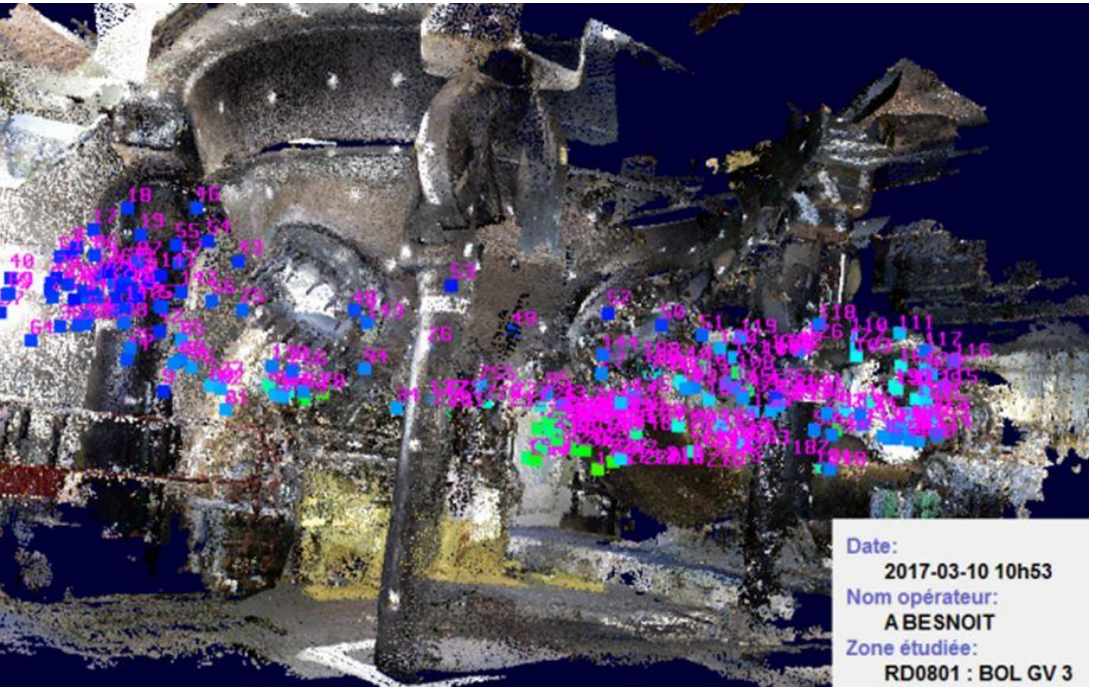
Precise and complete knowledge of the radiological state of the premises

PRODUCTIVITY

Intervention efficiency: 60m²/h



Cattenom 3D Mapping



Achievement of entry data for the inquiry of the Steam Generator Replacement at Cattenom 2 made by AREVA

PERFORMANCE

Preparation and optimisation of the work site

Reliability of entry data

QUALITY

Much more points

Automatic save

Outputs of MANUELA were inputs for VICTORIA

ALARA APPROACH

Reducing individual dose by increasing quality of the work site preparation

FEEDBACK

Belleville NPP:

- Workstation optimization
- Suitability and efficiency of lead protection
- Simulation and choice of optimized scenario

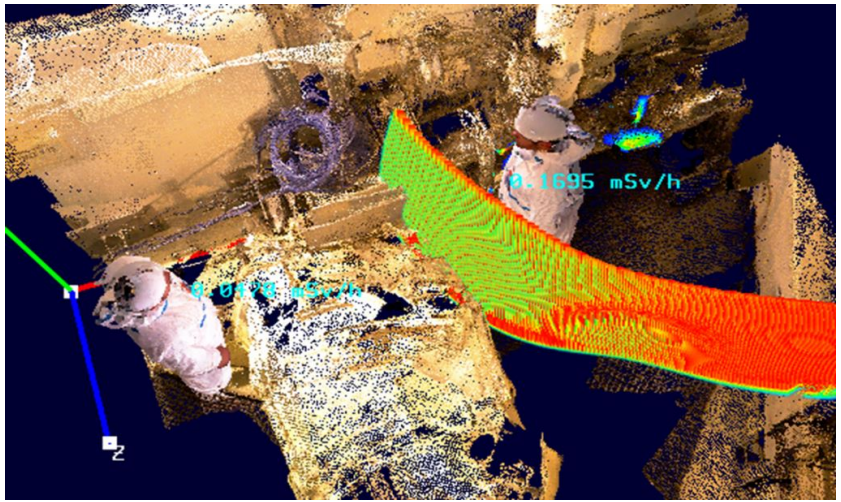
Fessenheim NPP:

- Visualization of the dose distribution in high stakes area

BENEF

- SAFETY
- DOSIMETRY
- WORK SITE PERFORMANCE
- COMMUNICATION

ALARA Approach in Belleville



DOSIMETRY	COMMUNICATION	WORK SITE PERFORMANCE
Visualisation of the isodose surface at 10 mRem/h Workstation optimisation (dose divided by 3)	Campaign to raise awareness of operators Better teaching methods in pre-job briefing	Workstation optimization Work site preparation optimization Choice of optimized protection

Conclusion

- Change in paradigme
- (examples of contacts measurements)

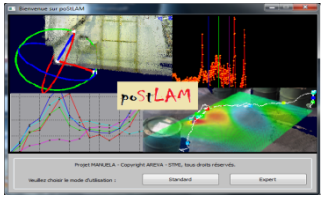
orano

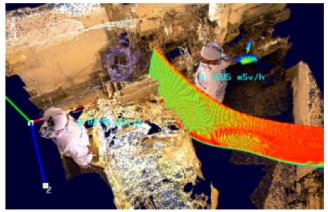
Donnons toute sa valeur au nucléaire

Overview of the MANUELA technology

Manuela
Measurement tool

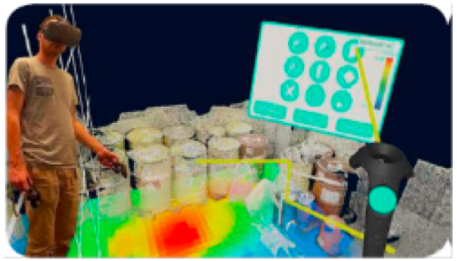
- 3D modeling and radiological mapping
- Dose rate, spectrometry (CdZnTe)
- Interpolation, retroprojection





PoStLAM
Post-treatment software

- Virtual space with measured data.
- Dimensions, isodoses.
- Dosimetry (avatar), spectrum ray selection (CZT)
- Expertise



MANUELA – VR
Virtual reality

- Immersion into the zone
- Virtual tape and radiameter
- Operation preparation
- Training