



ISOE

Date : 4 to 6 June 2024

Subject GAMMA CAMERA

An innovative tool to limit dosimetry
and contribute to the operational
performance of radiation protection

Prepared by Rémi BOURDELOIE & Marc LESTANG
(National Radiation Protection department)

ACCESSIBILITE : CONFIDENTIEL

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Chaque salarié s'engage à traiter de façon responsable les informations qu'il détient dans le cadre de son travail et respecter les règles de sécurité et de confidentialité, en particulier concernant les données sensibles.

Les bons reflexes

- Rester **discret** et vigilant dans les lieux publics
- Pour les documents sensibles, utiliser des **moyens de protection** adaptés (Stormshield Data Security)



Cette réunion aborde des sujets internes



Cette réunion aborde des sujets restreints dont la divulgation peut être préjudiciable à EDF : chacun s'engage à n'en communiquer les supports et à n'en relater les échanges qu'avec discernement et en mentionnant explicitement « à ne pas rediffuser / à ne pas divulguer »



Cette réunion aborde des sujets de nature confidentielle, chacun s'engage à tenir secrètes les informations tant écrites qu'orales qui y sont exposées.

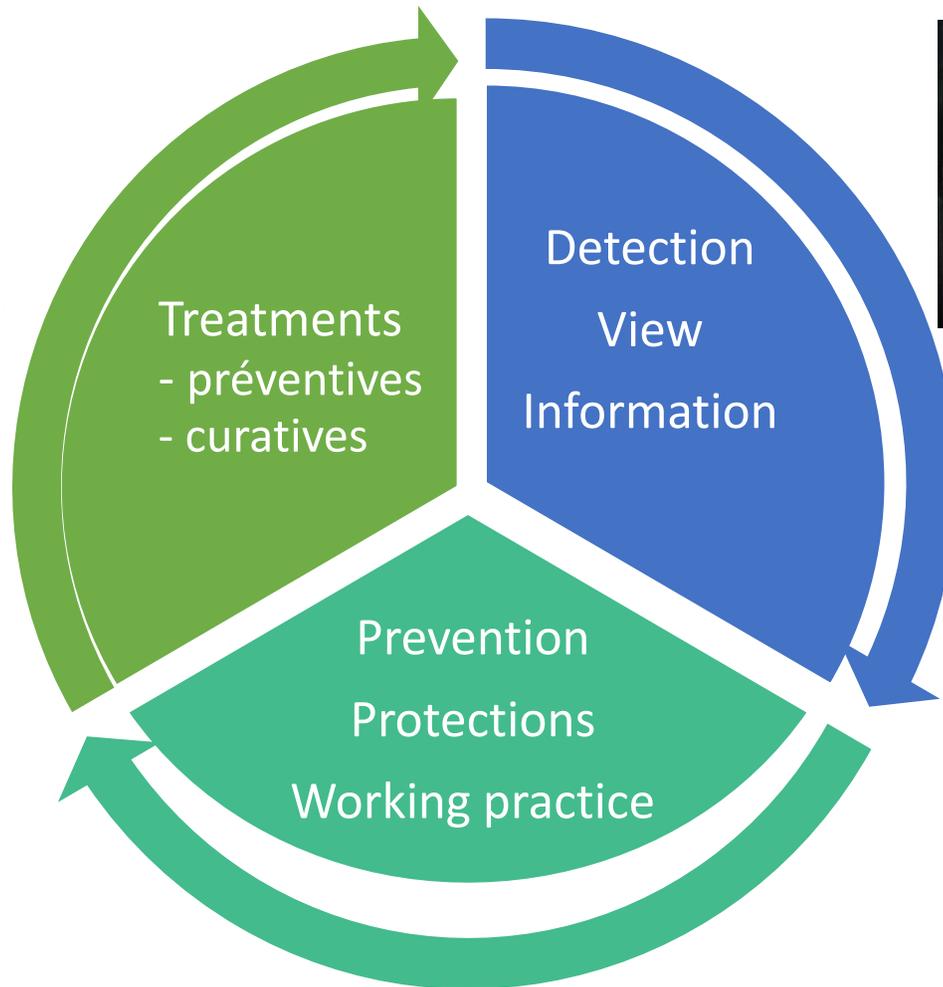
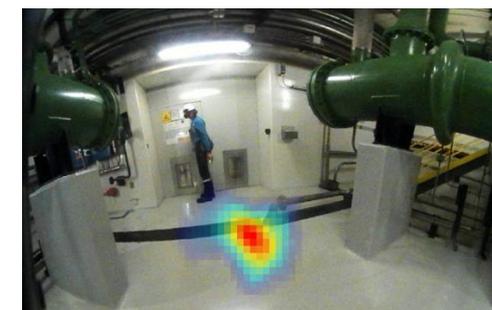
Chaque dépositaire de cette présentation s'interdit de la communiquer à quelque tiers que ce soit sans l'accord du président de séance

1. MAKE VISIBLE THE INVISIBLE

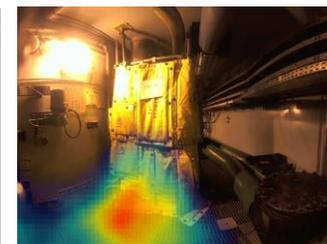
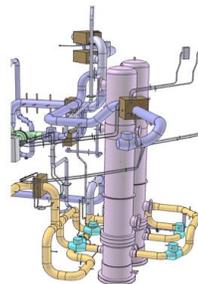


Latest gamma-ray imaging technology

Augmented reality



- Knowledge and Work on the source term
- Spectral analysis of deposits
 - Chemical clean-up
 - Hot spot elimination

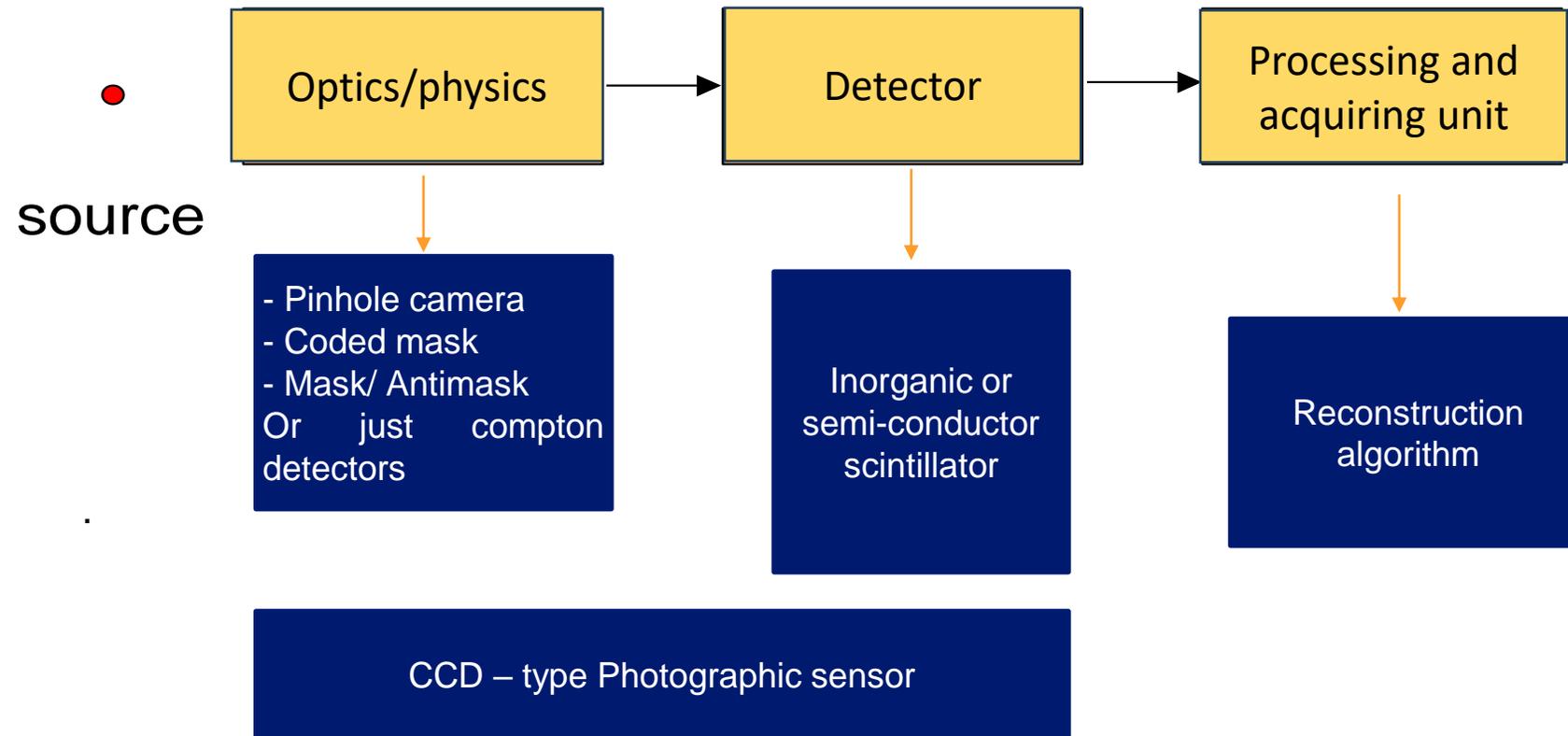


2. WHAT IS A GAMMA CAMERA



The Gamma Camera is a system to locate and characterise one or more radioactive sources in a 'scene'.

It comprises the following elements :

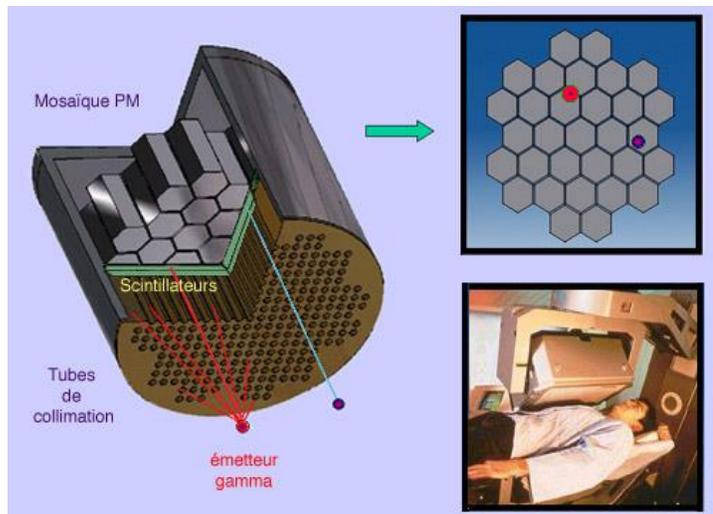
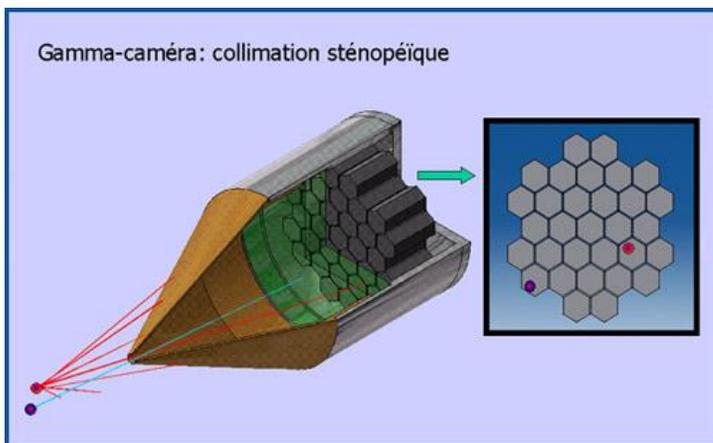


3. WORKING PRINCIPLE



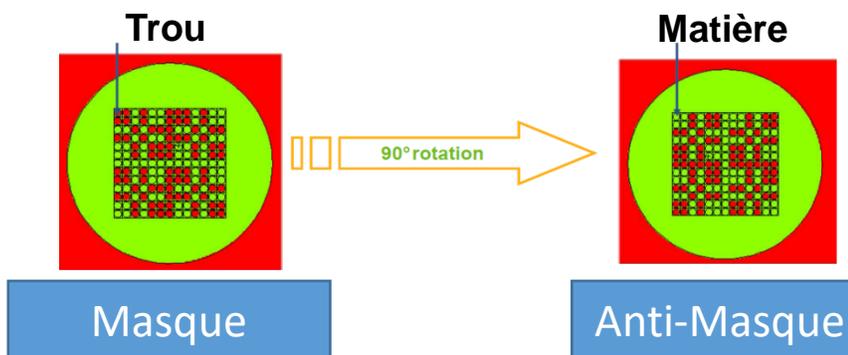
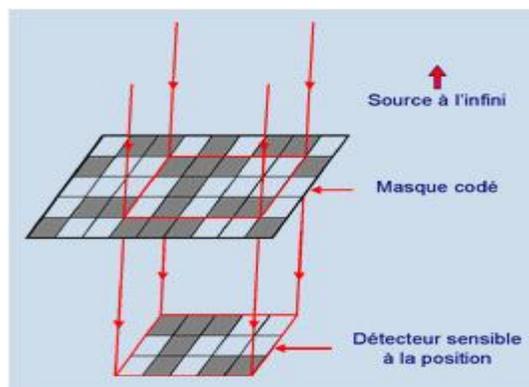
- **Pinhole or collimator**

- Originally medical imaging
- Principle of the pinhole



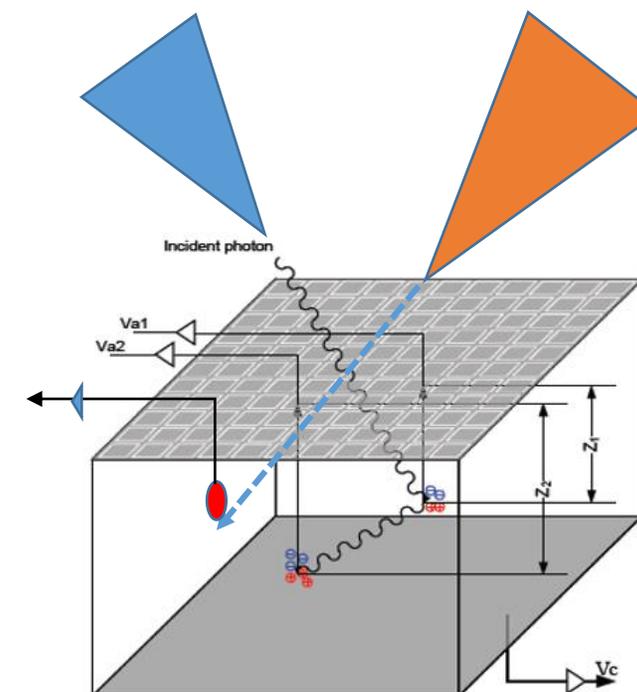
- **Coded mask**

- Originally for astronomy
- Improved signal-to-noise ratio
- Improved angular resolution
- Better spatial resolution
- Limited vision on one plane



- **Compton**

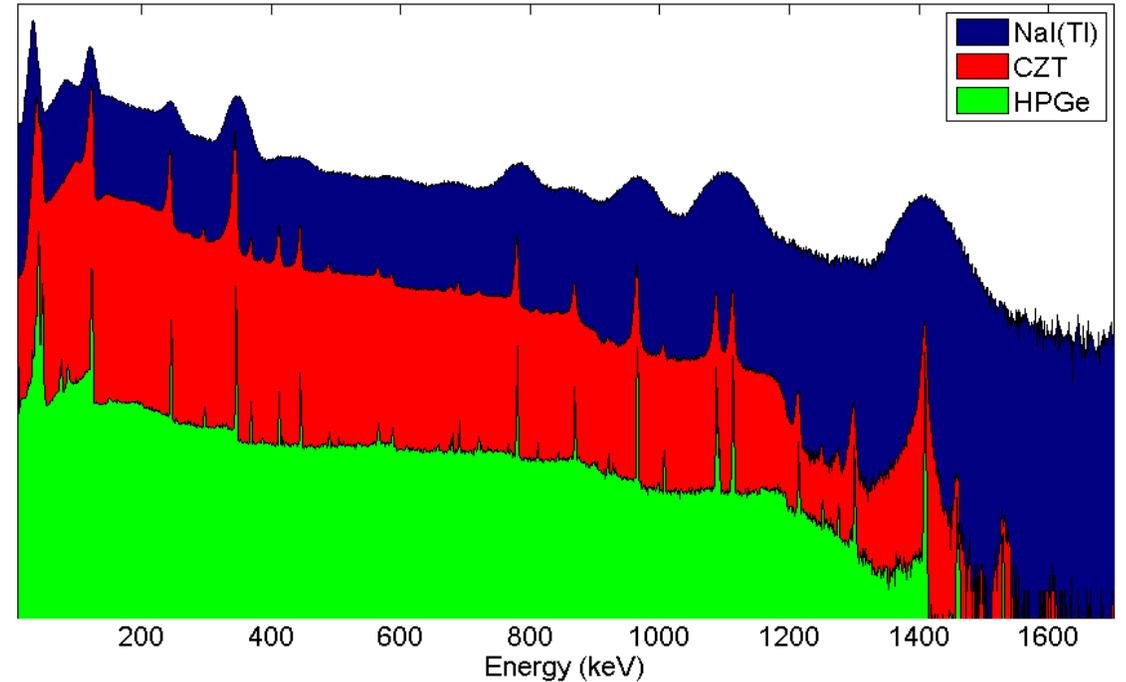
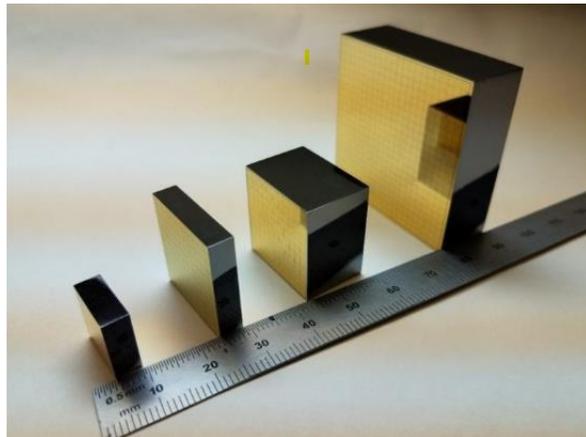
- Recording of photon interaction positions and deposited energy.
- 3D reconstruction by calculation.
- Layered detectors High energy threshold >250 keV



3. WORKING PRINCIPLE



- CdZnTe (or CZT) semiconductor detector: Cadmium Zinc Telluride
- Deposition of a thin layer of metal on the detector forming the electrodes
- Creation of electron-hole pairs when interacting with an ionising particle
- High detection efficiency,
- Good performance in gamma spectrometry at room temperature
- Ideal characteristics for creating reliable, compact detection systems



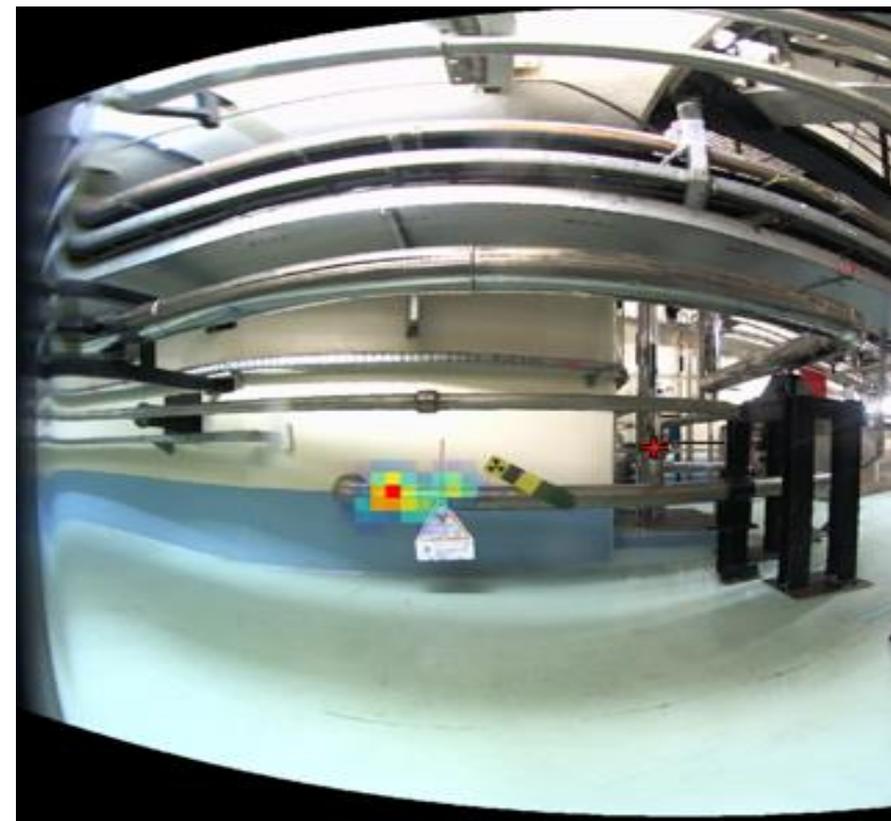
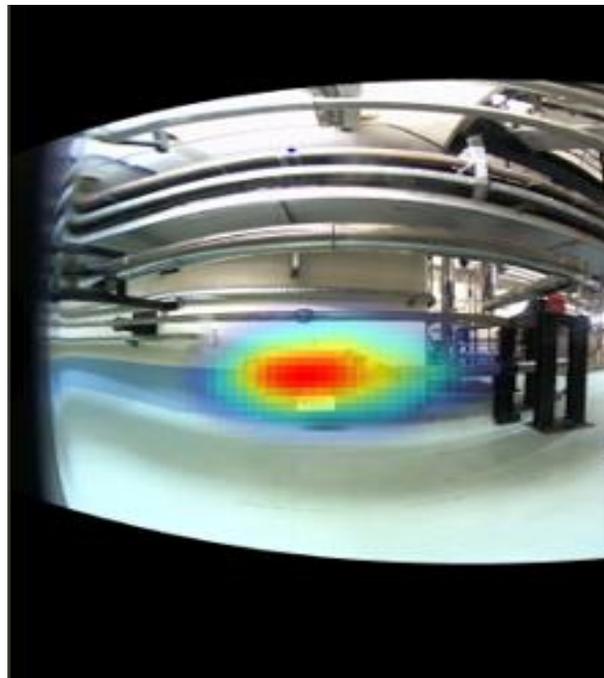
The resolution of the CZT (in red on the diagram) is sufficient to monitor and measure the isotopes of interest for the source term of the wafers.

In particular, for the detection of the main peaks of ^{58}Co , ^{95}Zr , ^{95}Nb , ^{54}Mn , etc. close to about 800 keV, it is better than NaI(Tl).

4. ILLUSTRATION OF APPLICATIONS (1/4)



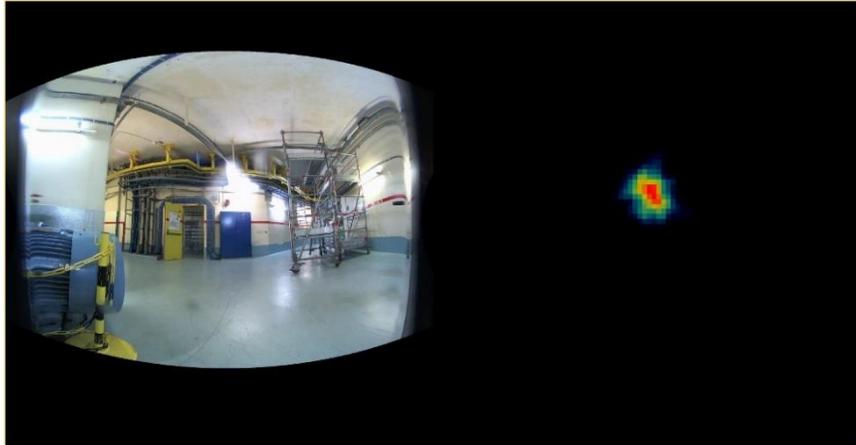
LOCATING A HOT SPOT



4. ILLUSTRATION OF APPLICATIONS (2/4)



360° VISION & DISCOVERY OF A HOT SPOT



HID401 Imaged Cts; Co-60; ptr_ban; 07:41



HID527 Imaged Cts; Co-60; ptr_ban_vue_arriere; 09:28



HID531 Imaged Cts; Co-60; ptr_ban_vue_arriere(High Res.); 09:28



4. ILLUSTRATION OF APPLICATIONS (3/4)



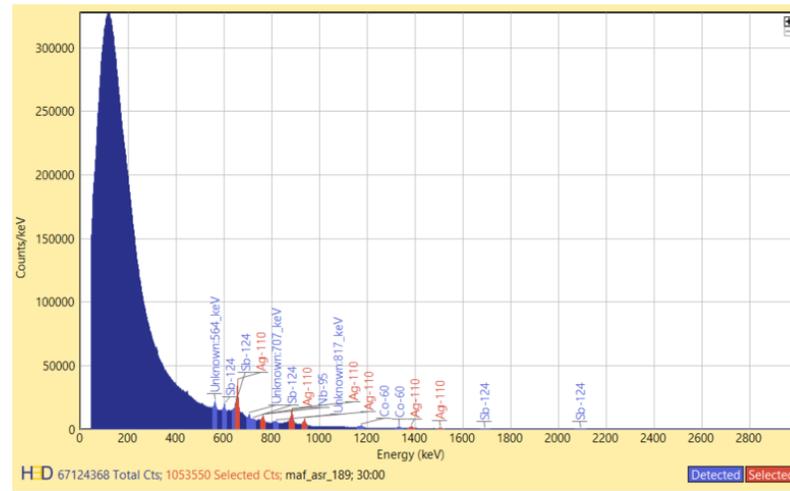
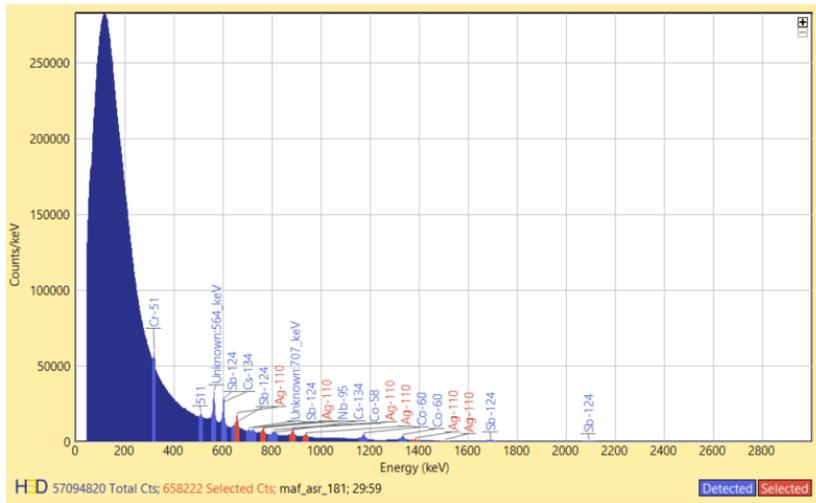
RCV CIRCUIT MONITORING DURING THE SHUTDOWN ON TRICASTIN

Start of oxygénation :

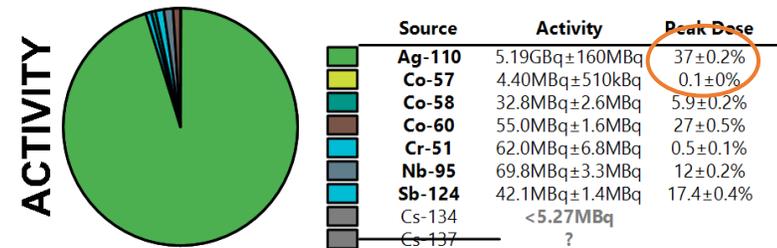
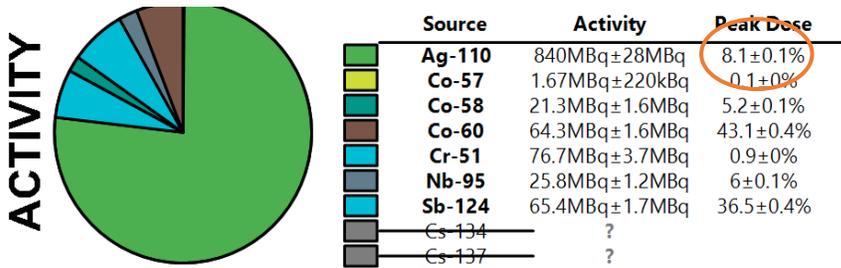
$^{110m}\text{Ag} = 8 \%$

End of oxygénation :

$^{110m}\text{Ag} = 37 \%$



Evidence of recontamination by redeposition of ^{110m}Ag in the RCV circuit



4. ILLUSTRATION OF APPLICATIONS (4/4)

WORKPLACE ANALYSIS : RECOMMENDATIONS INSTALLATION OF ADDITIONAL PROTECTION

Using the gamma-camera on the RCV site :

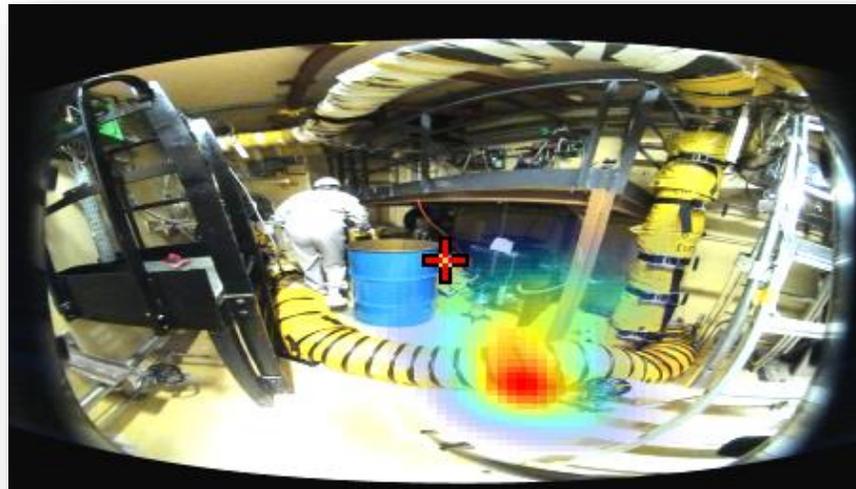
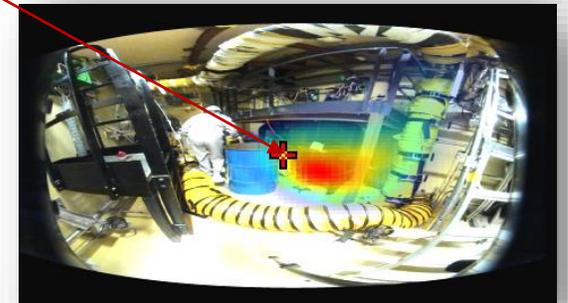
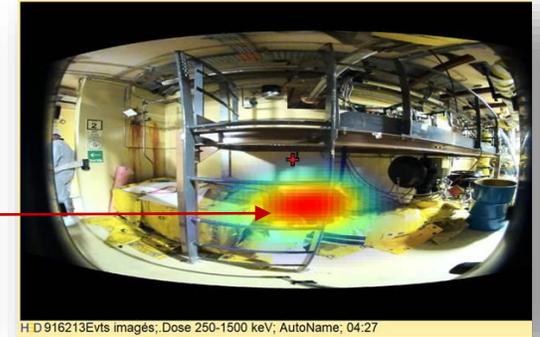
During the first acquisition, the dose rates come mainly from the bend of the RCV001EX and the valve of the RCV007VP.

=> Witch confirmed the need for radiological protections.

During the following acquisitions, discovery of an irradiating valve that had not been identified during the first mapping.

In this zone, 25% of the dose comes from a depot of cobalt which is located in the valve under the flexible..

→ Additional lead installation was required on this valve.



5. HOW THE GAMMA CAMERA WILL CHANGE OUR PRACTICES (1/2)



For radiation protection on our sites :

- Remote location and characterization of hot spots,
- Assist with the risk analysis of the workplace,
- Checking the effectiveness of biological protection systems.
- Stronger partnership between logistics and risk prevention.

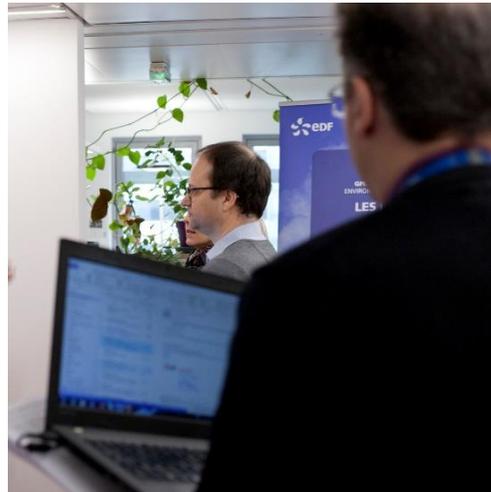
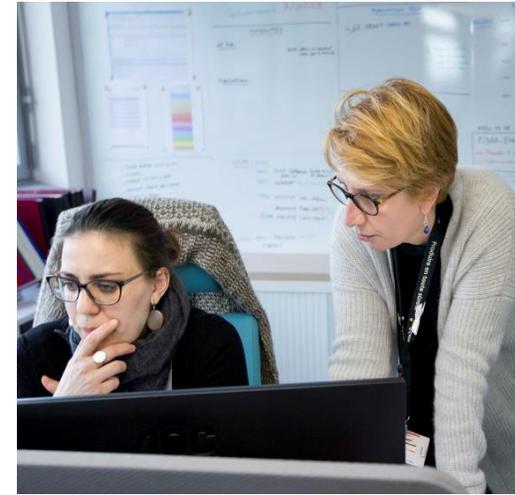


For analysis and understanding of source term :

- Monitoring and evaluating the effectiveness of decontamination processes
- Help in diagnosing and monitoring the evolution of the source term, and propose appropriate preventative measures,
- Focus our actions and strategy on the source term.

For a common approach to risk across all departments :

- Illustration of work procedures or operating modes with visuals
- Improved representation of source term location for better risk perception



MAKE VISIBLE THE INVISIBLE FOR A
BETTER RADIATION PROTECTION
AT EDF

Thank you

