A Portable Gamma Imaging System dedicated to the Detection and the Direct Visualization of Hot Spots (mainly ^{60}Co) in Nuclear Power Plants

Emmanuelle Gaillard-Lecanu*, Daniel Hameau*, Hervé Onillon*, Sylvie Jahan*, Estelle Courageot*, Vincent Schoepff[+], Frédérick Carrel[+], Mehdi Gmar[+] , Jean-Eric Maurer[§], Julien Vénara[#], Charly Mahé[#], Marc Lestang[&], Alexandre Arnette[&]

*** EDF R&D, STEP, 6 quai Watier, 78401 Chatou Cedex, France**
[+] CEA, LIST, 91191 Gif-sur-Yvette Cedex, France
[§] EDF DPN/TRI, Site du Tricastin, BP 9, 26130 Saint-Paul-les-Troix-Chateaux, France
[&] EDF DPN/UNIE 1, place Pleyel, 93200 Saint-Denis, France
[#] CEA DEN, DTEC, Site de Marcoule, BP 17171, 30207 Bagnols-sur-Cèze Cedex, France

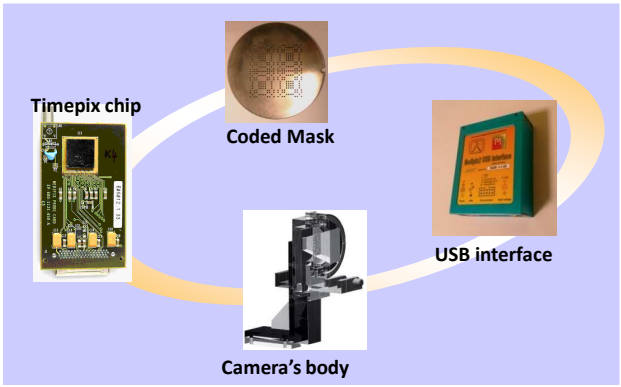
FRAMEWORK

In a nuclear power plant (NPP), the localization of radioactive hot spots is a major issue, as they are responsible for a significant part of the doses received by the workers, especially during maintenance operations. They are mainly due to the presence in the water of activated corrosion products, ^{60}Co / ^{58}Co, as well as some other radionuclides, and hence are encountered in pipes.

OBJECTIVE: to observe, on the same view, the visible image AND the gamma image of a scene, in real-time

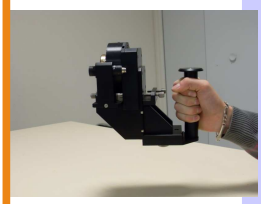
The requirements are:
- Weight ≤ few kg (the currently available gamma camera ≤ 40 kg)
- Easiness to handle and use, optimized for ^{60}Co / ^{58}Co detection
- Robustness
- Decontamination possible
- Possibility of a camcorder mode in addition to the tripod mode

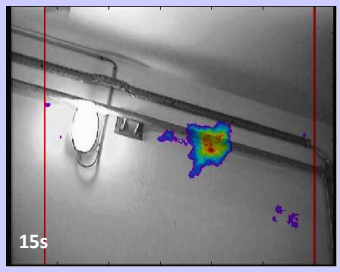
THE GAMMA CAMERA GAMPIX



GAMPIX is based on three main components: the Timepix pixellated chip, hybridized to a 1 mm thick CdTe substrate, a coded mask used as a multi pinhole collimator and a USB module to connect the control computer to the gamma camera.

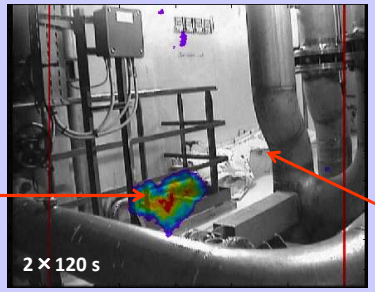
Two modes available for background management :
- 1 shot (measurement time ≈ 10 – 100 sec) + average background subtraction
- 2 shots - 1 in mask position + 1 in anti-mask position (measurement time 2 × 1 shot)



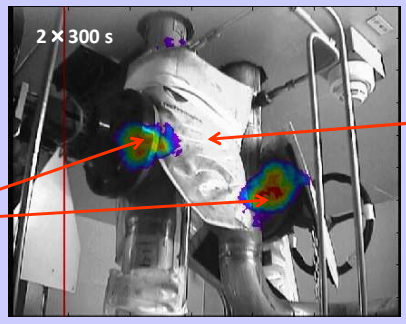


Use in the camcorder mode

RESULTS



Partial shielding of a pipe



Detection of leakage lines in a shielding

PERSPECTIVES

GAMPIX is still under development. Further work concerns:
- Ability to analyze the gamma image in order to roughly assess the energy spectrum of the source
- Quantify the S/N ratio in laboratory, as well as, if possible, by carrying out an experiment in given conditions on-site (nuclear power plant)
- Work on the ergonomics and the easy-to-use objective ("push button system")

OTHER POSSIBLE USES

- Security in gammagraphy
- Waste management
- ….

Contact EDF R&D :
Emmanuelle Gaillard-Lecanu
Emmanuelle.gaillard-lecanu@edf.fr