



Detection, Measurement, Protection... For a Safer World

Preliminary

# SPIR-Ident HYDRO presentation SPIR-Ident AIR introduction



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# SPIR-Ident HYDRO purpose

- The SPIR-Ident Hydro is intended to monitor by real-time spectrometry river water and waste water from nuclear installations or hospitals,
- It provides continuous and fully automated overall measurement, region of interest measurements and real time identification with related quantification even of mixed isotopes.
- The software allows local and/or remote information display. It has been developed for quick and easy view of long monitoring periods
- Data can be easily integrated in a country large network



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# Main advantages

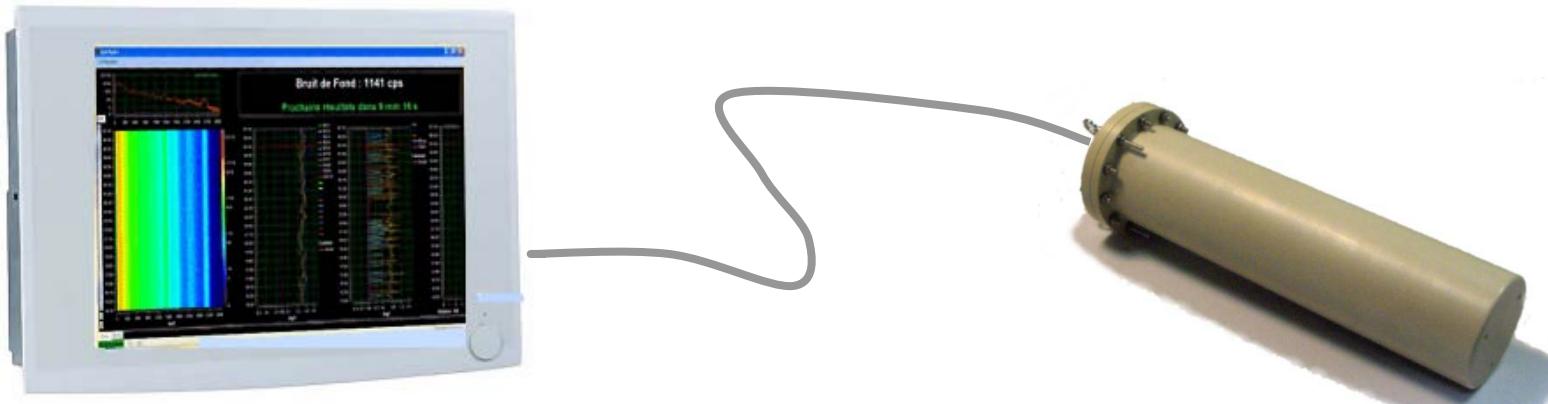
- **Very robust probe:**
  - hardened NaI(Tl) detector + on board digital MCA,
  - resistant PEEK envelop + marine grade stainless steel
- **Usable in dirty waste station water, in sea water,**
  - underwater down to -10m (*more on request*)
- **Fully automated use, self stabilized,**
- **Accumulation over with two dwell periods,**
  - combining fast response time to detect a change and long measurements for finding weak contribution.
- **Double analysis by ROIs and by ID algorithm**
- **Very sensitive**
  - Minimal detectable activity <1 Bq/l to a few Bq/l
- **Spectra and isotope specific waterfall view**
- **SQL data base and xml files for remote view.**



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# SPIR-Ident HYDRO presentation



- Panel PC or industrial PC
- Standalone or networked remote operation
- SPIR-Ident server + Monitor user interface

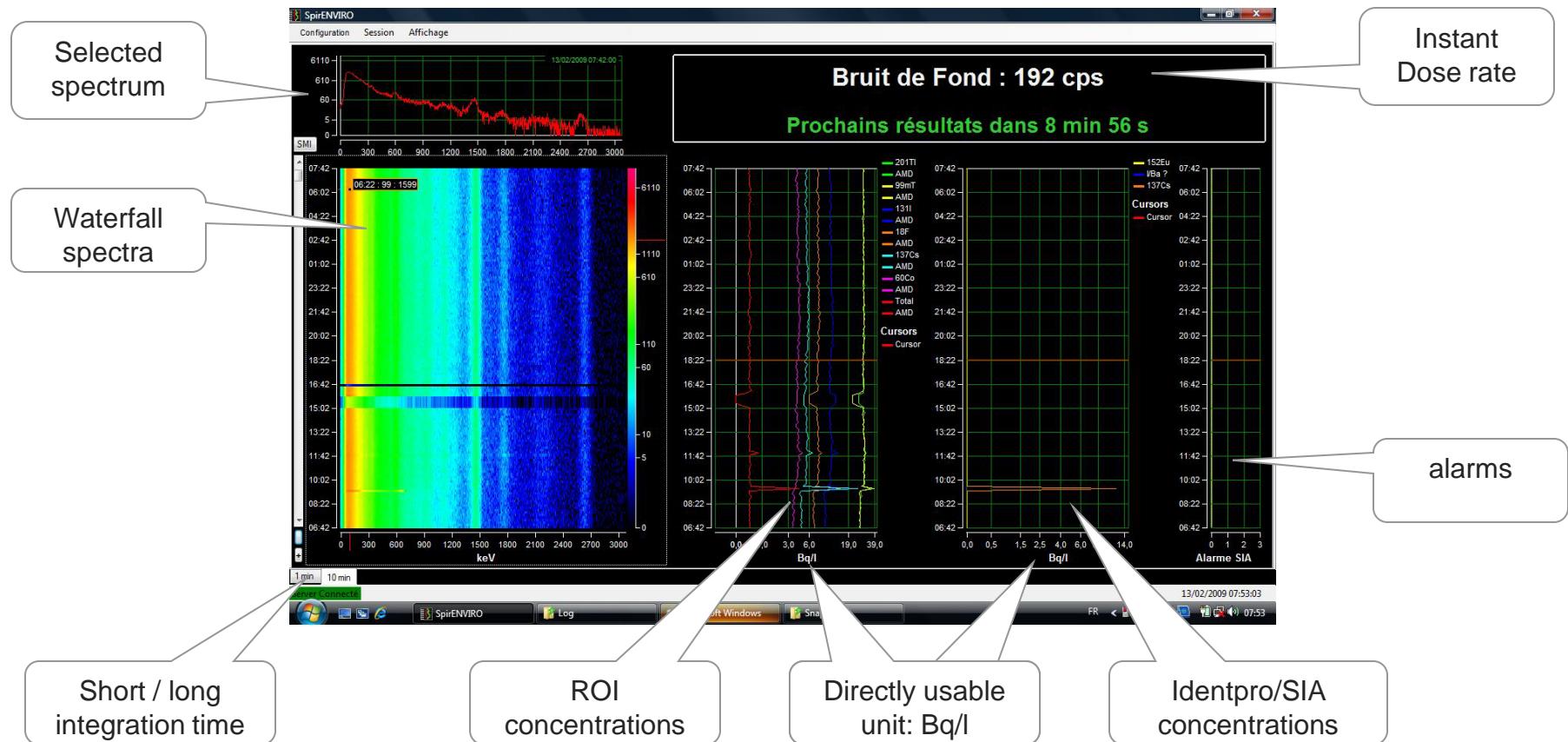
- NaI(Tl) 3\*3" hardened detector
- MCA digital 1024ch
- PEEK and stainless steel
- Holdings for hanging-up or rod attachment
- Long cable available up to 30m



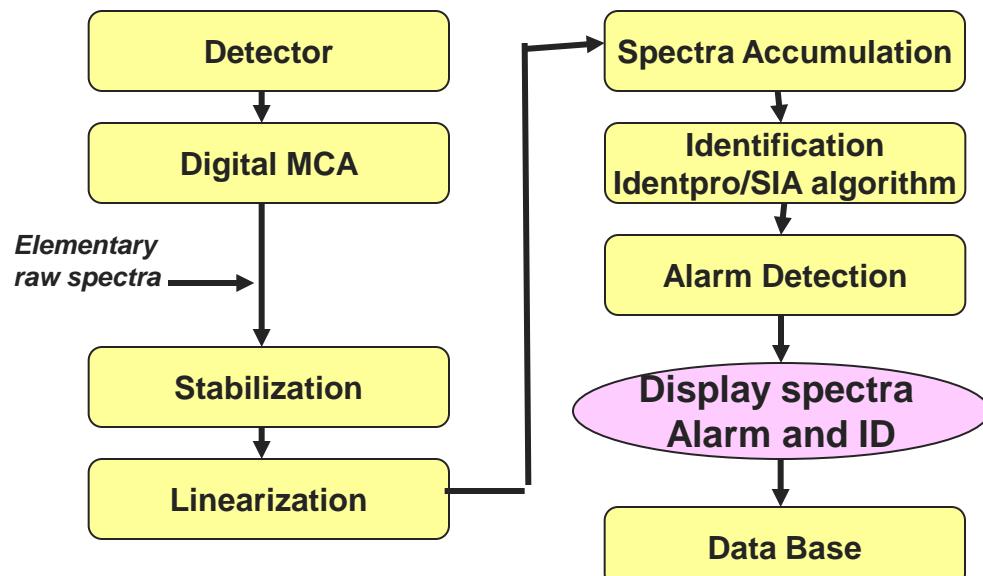
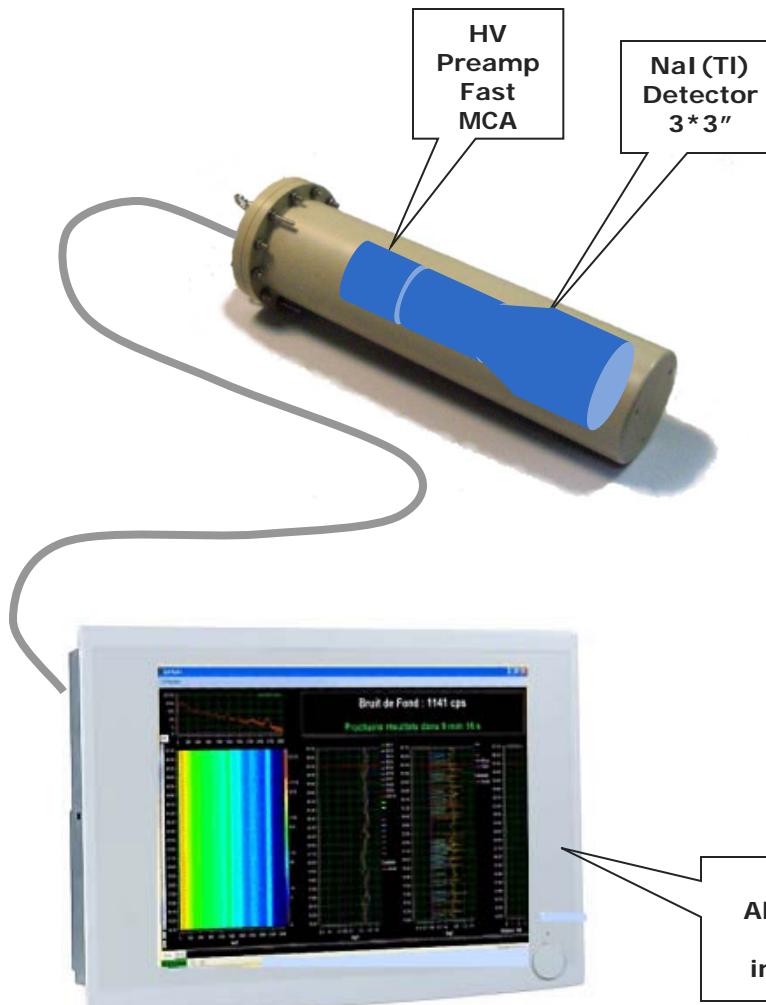
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# Monitoring user interface



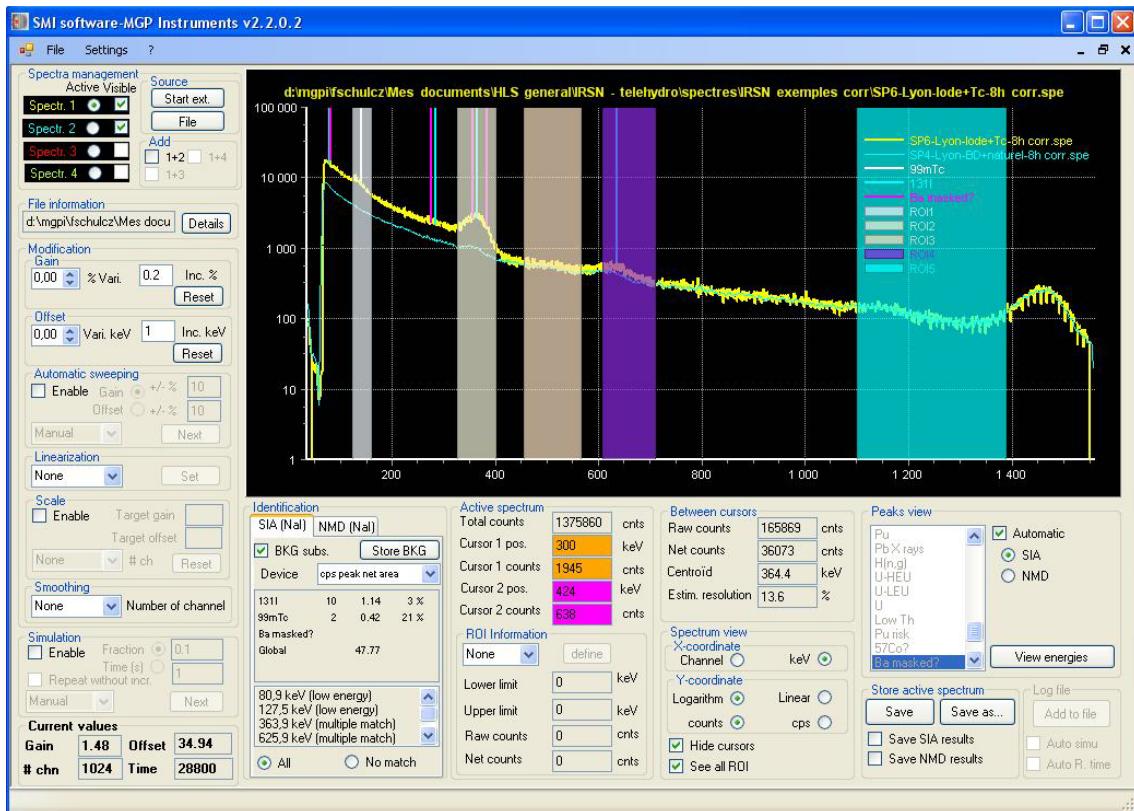
# SPIR-Ident HYDRO technology



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# Activity estimation ROI method



- + very sensitive
- needs separates ROI
- OK for single isotope or well separated
- Caution if used in an automated mode

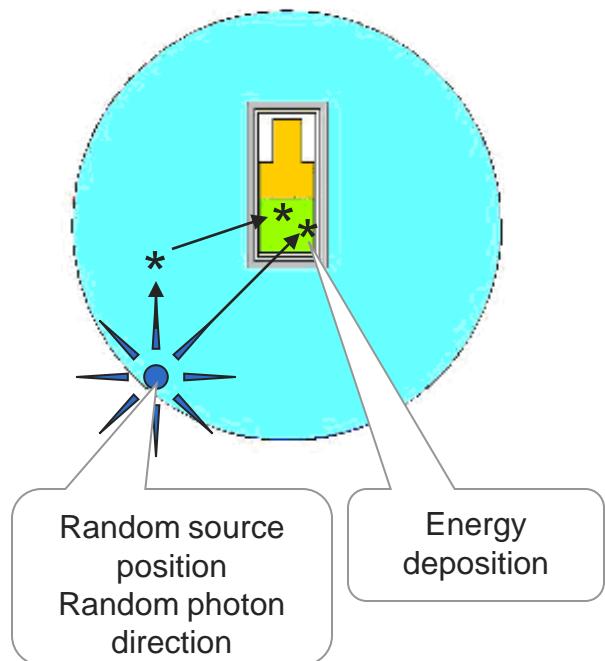
	Définition ROI (en keV)	Sensibilité ROI (c/s)/(Bq/l)
<b>201Tl</b>	<b>54-90</b>	<b>0,21</b>
<b>99mT</b>	<b>123-159</b>	<b>0,15</b>
<b>131I</b>	<b>327-399</b>	<b>0,19</b>
<b>18F</b>	<b>456-567</b>	<b>0,5</b>
<b>137Cs</b>	<b>606-711</b>	<b>0,2</b>
<b>60Co</b>	<b>1101-1389</b>	<b>0,2</b>



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# Underwater detector simulation



- Use of MCNP >> spectra for various isotopes for a given concentration
- MCNP needed rather than analytical calculation because a lot of scattering and built –up: spectra appear smeared
- 1m of water around the detector is enough
- We obtained
  - Spectra for various isotopes
  - Optimum ROI definition and related sensitivity
  - Identpro/SIA sensitivity
  - Equivalence between volumic sources and point sources

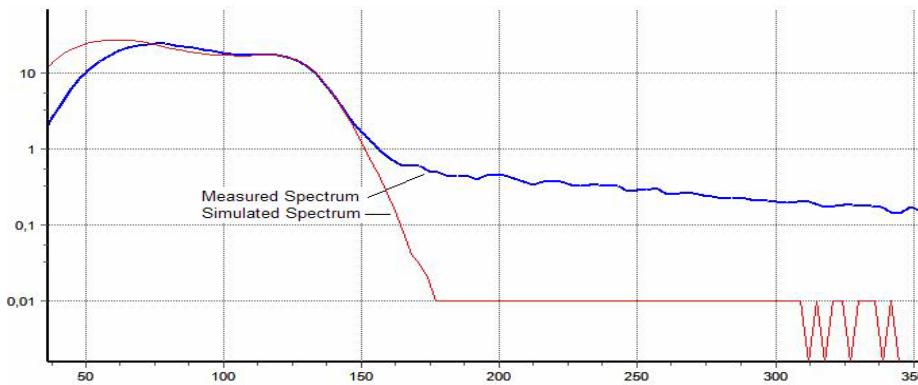


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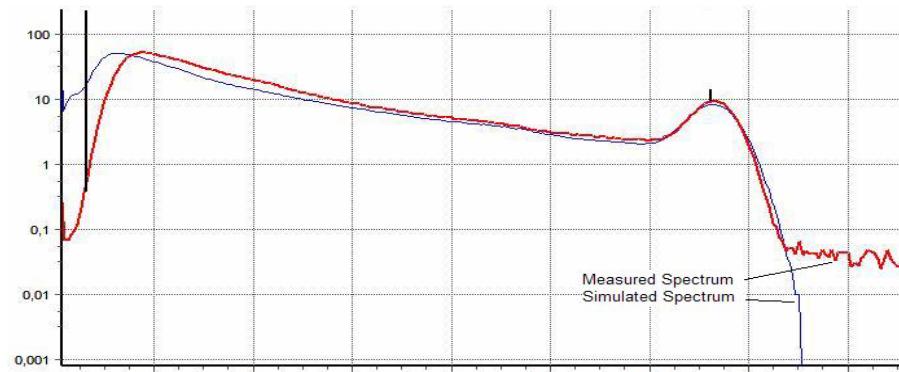
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# Simulation and experience



**Co-57**, source ponctuelle placée à 20cm (radial) du centre du détecteur plongée dans un bain d'eau. Activité de 58,714 kBq



**Cs-137**, source ponctuelle placée à 25cm (radial) du centre du détecteur plongée dans un bain d'eau. Activité de 294 kBq.

- Comparison between simulated spectra and point source spectra at the “equivalence” distance
- Check of the sensitivity calculation

Isotopes	Sensibilité simulée	Sensibilité mesurée	Déviation	Précision mesure
<b><math>^{57}\text{Co}</math></b> (1)	<b>0,632</b>	<b>0,656</b>	<b>3,7%</b>	<b>7%</b>
<b><math>^{137}\text{Cs}</math></b>	<b>0,386</b>	<b>0,372</b>	<b>3,7%</b>	<b>5%</b>
<b><math>^{60}\text{Co}</math></b>	<b>0,204</b>	<b>0,198</b>	<b>3%</b>	<b>5%</b>



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# Performance Minimal Detectable Activity

$$AMD_{ROI} = \frac{2.71 + 4.56 * \sqrt{bdf * tps}}{tps * s}$$

Isotope s	AMD (en Bq/l) tps=10min	AMD (en Bq/l) tps=2heures
<sup>99m</sup> T	5,83	1,68
<sup>131</sup> I	3,16	0,91
<sup>137</sup> Cs	1,88	0,54
<sup>60</sup> Co	2,3	0,66

Isotope s	AMD (en Bq/l) tps=10min	AMD (en Bq/l) tps=2heures
<sup>99m</sup> T	2,15	0,61
<sup>131</sup> I	1,53	0,44
<sup>137</sup> Cs	1,06	0,3
<sup>60</sup> Co	1,68	0,4

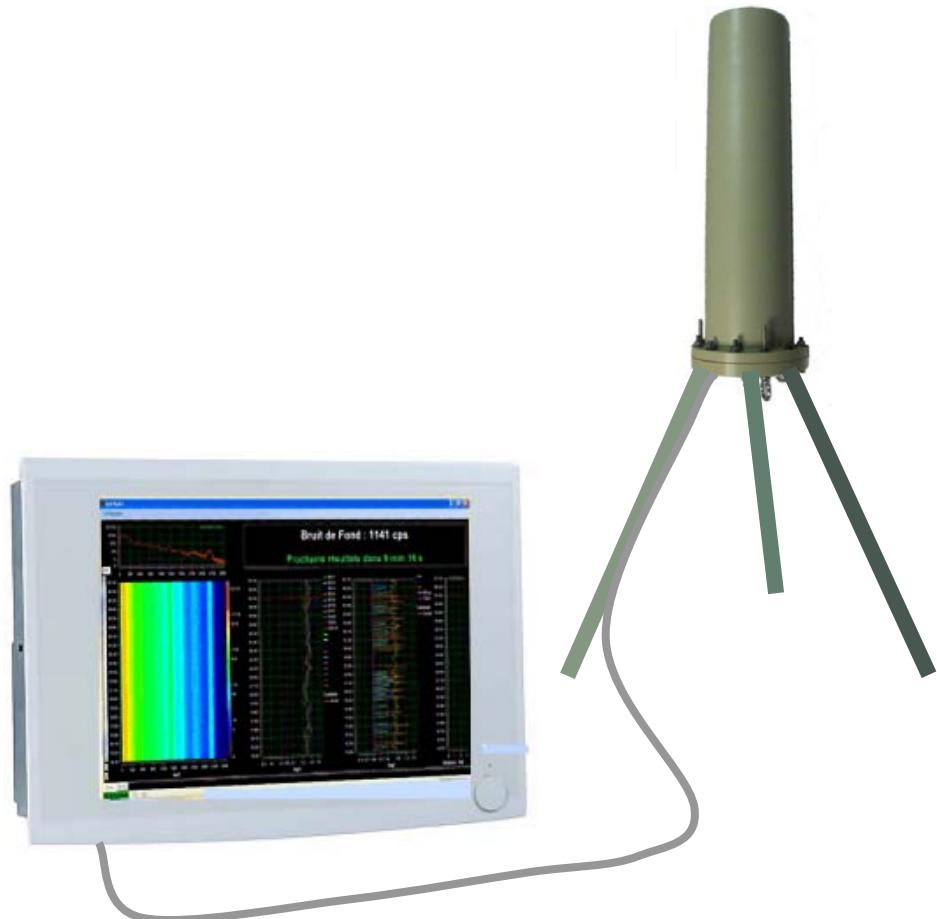
- Considering 5% error or type 1 and type 2
- Very depending of local background despite water attenuation
- AMD improves as square of integration duration

**>> short time 10min,  
1 to 10 Bq/l**

**>> long time 2 h,  
0,3 to 2 Bq/l**



# SPIR-Ident AIR



- Same detector assembly used for ambient environmental measurements
- Provides clear discrimination from background or unexpected sources ( medical nearby)
- << 10 nSv/h contribution can be detected and identified despite background changes

more than a decade gain of the limit of detection over gross counting system.

Identification and false alarm rejection are built-in



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# SPIR-Ident AIR performances



- Example of detection and identification of traces of Tchernobyl remaining contamination (south of France)
- About 1 nSv/h contribution ie about 1000 Bq/m<sup>2</sup> equivalent at the surface
- Is identified by Identpro/SIA