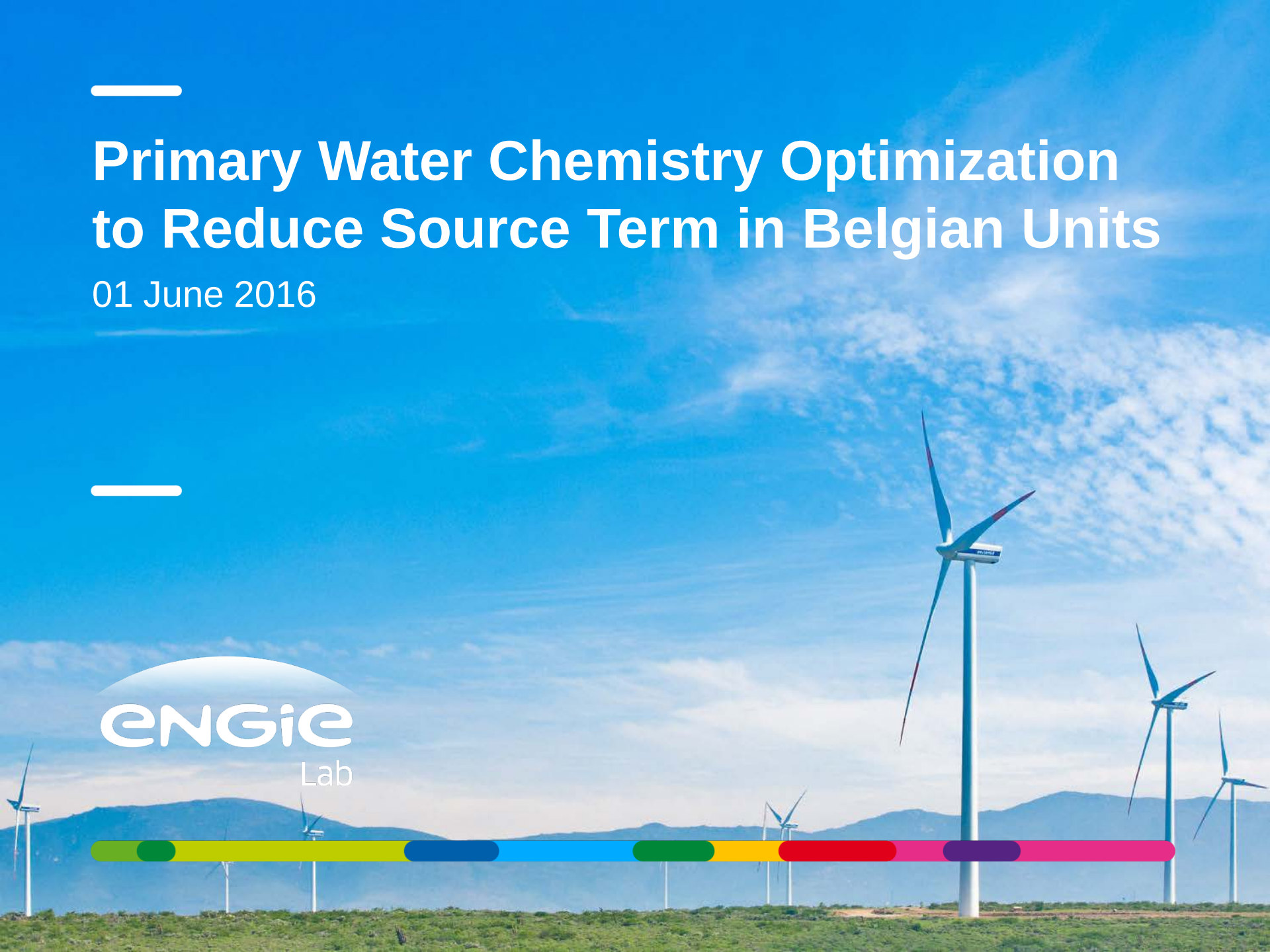
Primary Water Chemistry Optimization to Reduce Source Term in Belgian Units

01 June 2016



7 reactors totalising about 6000 MW

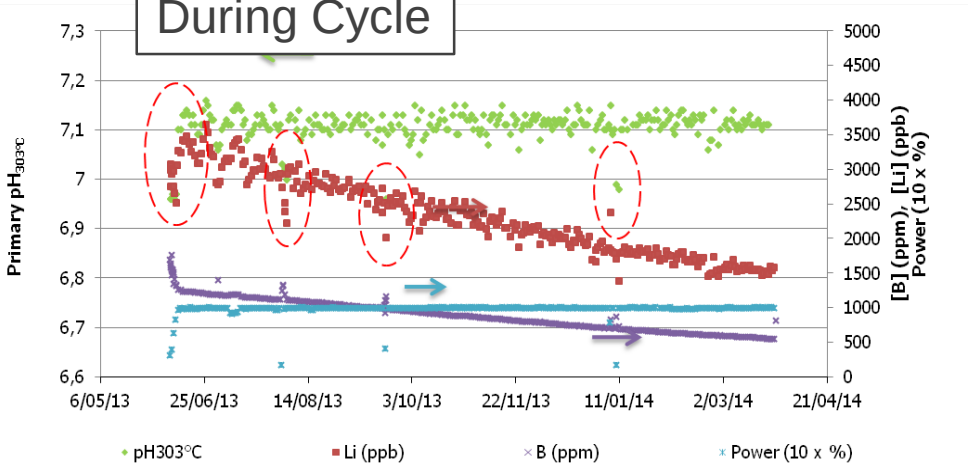
Goal of Laborelec

Optimize the primary water chemistry to

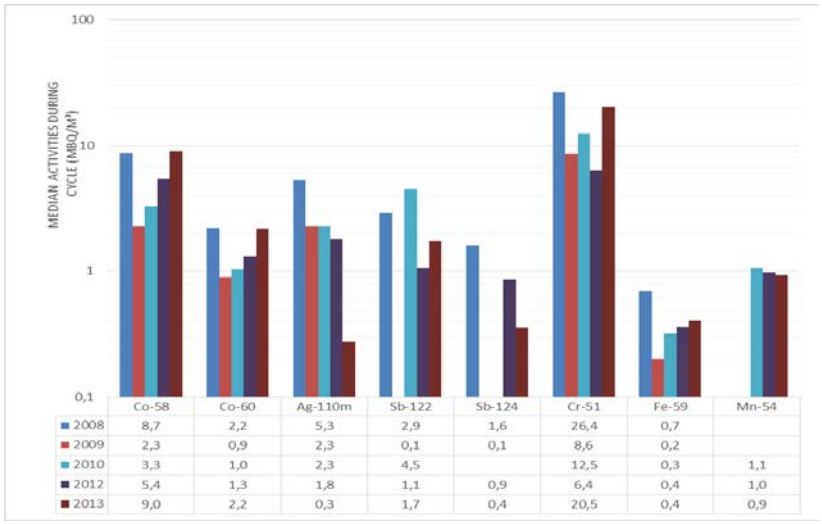
- Maintain the integrity of the circuit
- Mitigate local and general corrosion
- Reduce dose rates

Follow up of the primary circuits

During Cycle

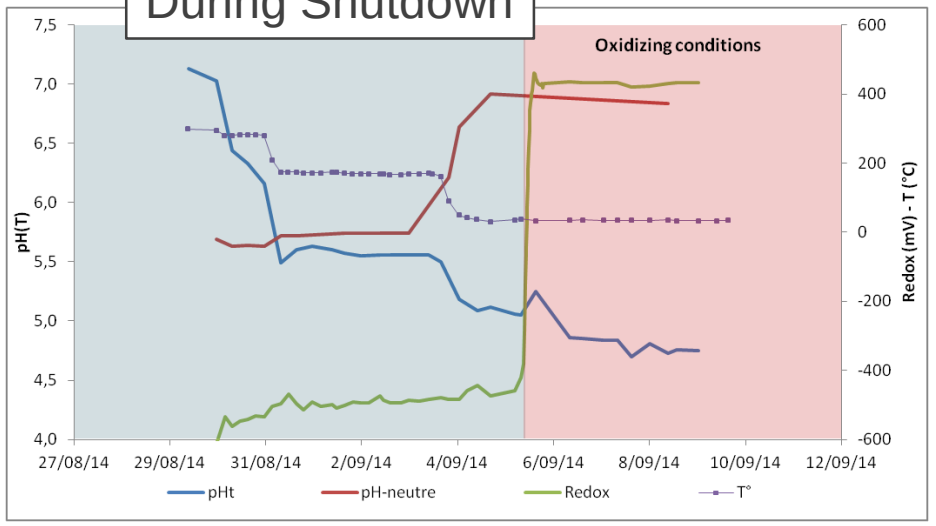


- Examination of the chemical parameter results
- Analysis of the abnormal results
- Recommendations



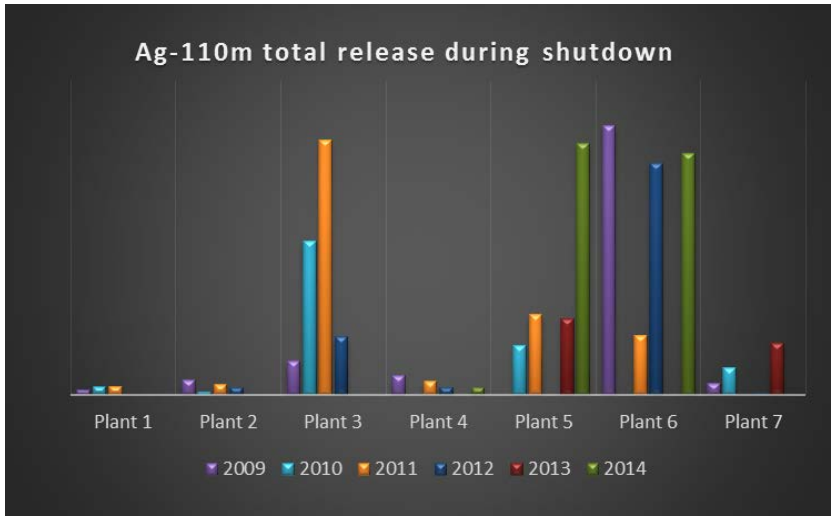
	Co-58	Co-60	Ag-110m	Sb-122	Sb-124	Cr-51	Fe-59	Mn-54
2008	8,7	2,2	5,3	2,9	1,6	26,4	0,7	
2009	2,3	0,9	2,3	0,1	0,1	8,6	0,2	
2010	3,3	1,0	2,3	4,5		12,5	0,3	1,1
2012	5,4	1,3	1,8	1,1	0,9	6,4	0,4	1,0
2013	9,0	2,2	0,3	1,7	0,4	20,5	0,4	0,9

During Shutdown



Follow up of the primary circuits

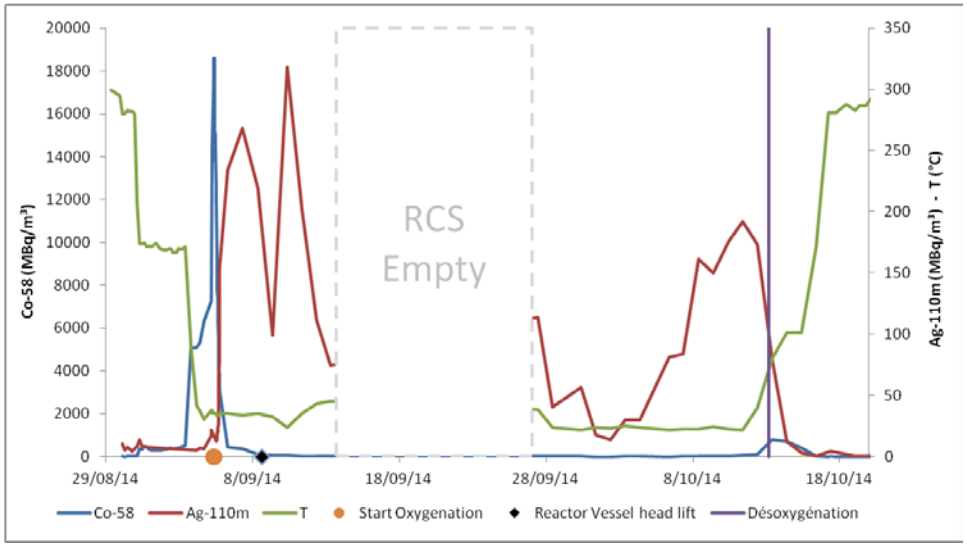
^{110m}Ag issue



Ag(-110m) capture during oxidizing condition

~~Ag(-110m) release during reducing conditions~~

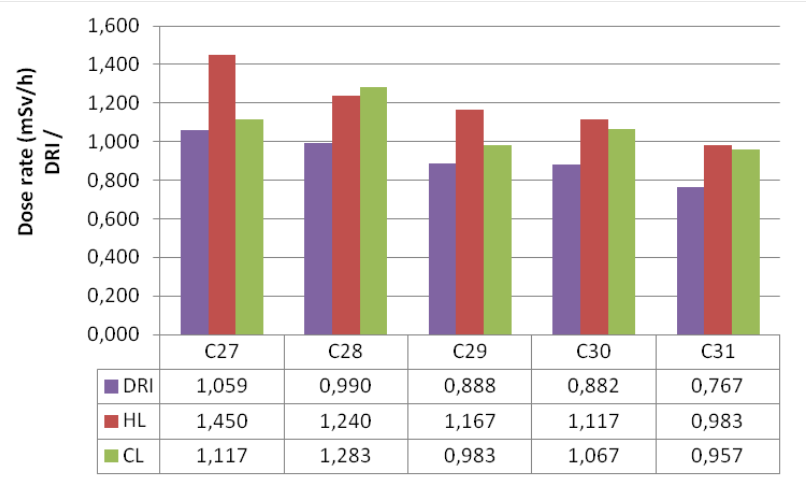
- ❑ Investigation on the ^{110m}Ag sources
- ❑ Oxygenation
- ❑ IEx management



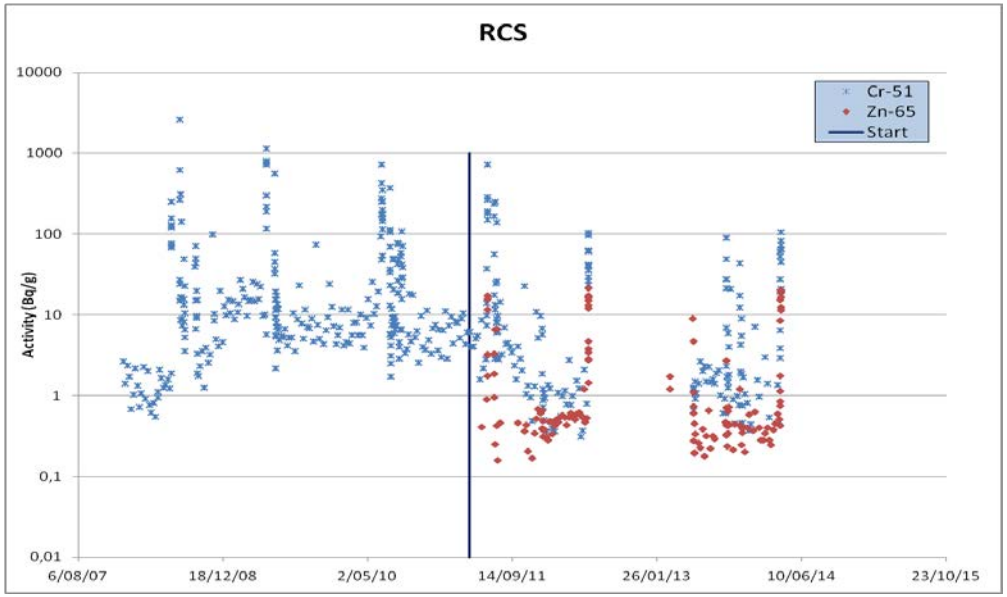
Follow up of the primary circuits

Zn I n RCS KCD3 (dose rate reduction purpose)

- Injection program initiated 2 months before end of cycle 29
- [Zn] target in RCS : 5 µg/kg
- 1 year cold shutdown (C30 – C31)
- No larger decrease in DRI has been noticed as the result of zinc addition.



	C27	C28	C29	C30	C31
DRI	1,059	0,990	0,888	0,882	0,767
HL	1,450	1,240	1,167	1,117	0,983
CL	1,117	1,283	0,983	1,067	0,957

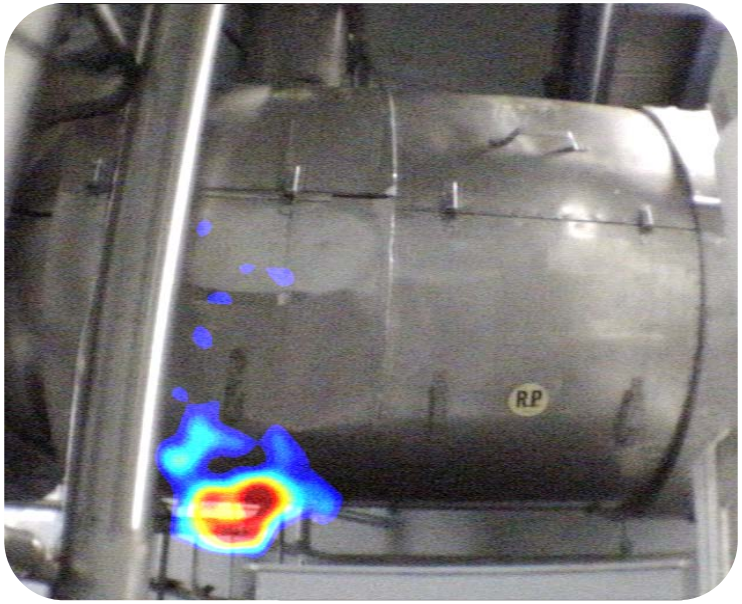


Use of Gamma camera to evaluate measurement points for dose rate index

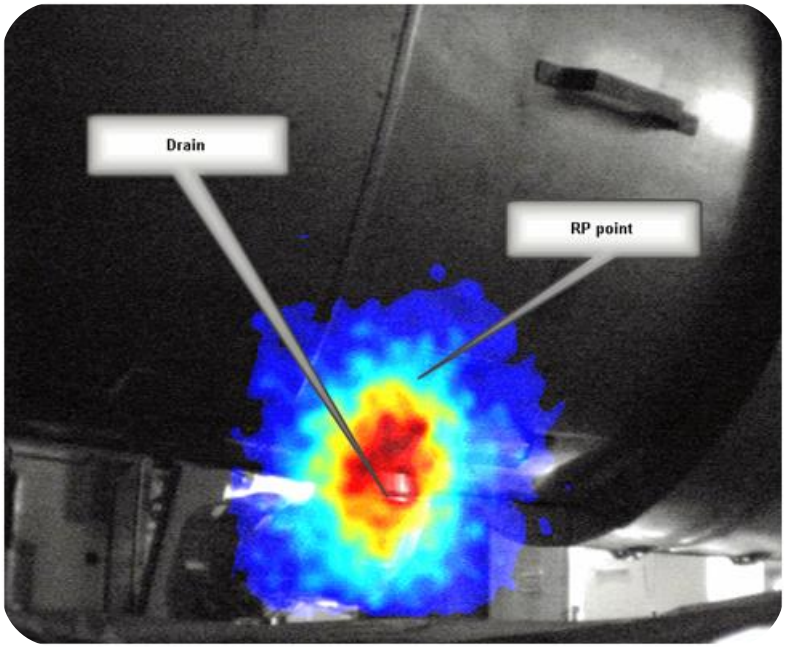
- The DRI is used to evaluate the effectiveness of the source term reduction initiatives .
- DRI can be influenced by surrounding systems.
- An imaging system developed via a collaboration project between CEA and ENGIE
- Gamma camera helps to identify the contribution of surrounding systems to the dose rate measured
- Associated CZT detector helps to determine the isotopic composition of the contamination.

Use of Gamma camera to evaluate measurement points for dose rate index

Plant 1 : No influence

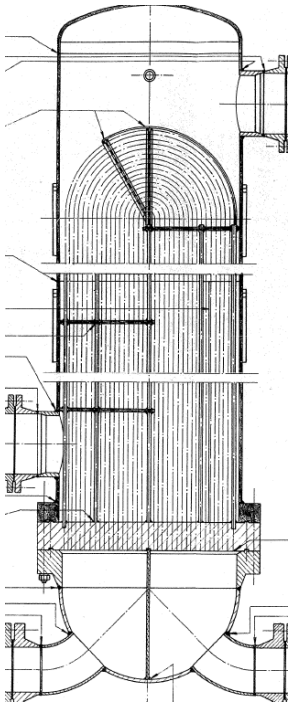


Plant 2 : Small influence. Recommandation made to relocate the DR measurement point



In-situ Gamma Spectrometry

- Spectrum acquired with $LaBr_3$ detector
  - Quick detector
  - Easy to handle (does not require liquid nitrogen)
  - Relatively good FWHM
  - Quantitative measurement
- Modeling with ISOCS



HLR				
Poids	Surface XXX	Epaisseur XXX		
Mesure			Mesure	Arrêt
Isotope	Bq (RC)	Bq	Bq/m²	Bq/m²
Cr-51				
Co-58				
Co-60				
Ag-110m				