



**sck cen**  
Belgian Nuclear Research Centre

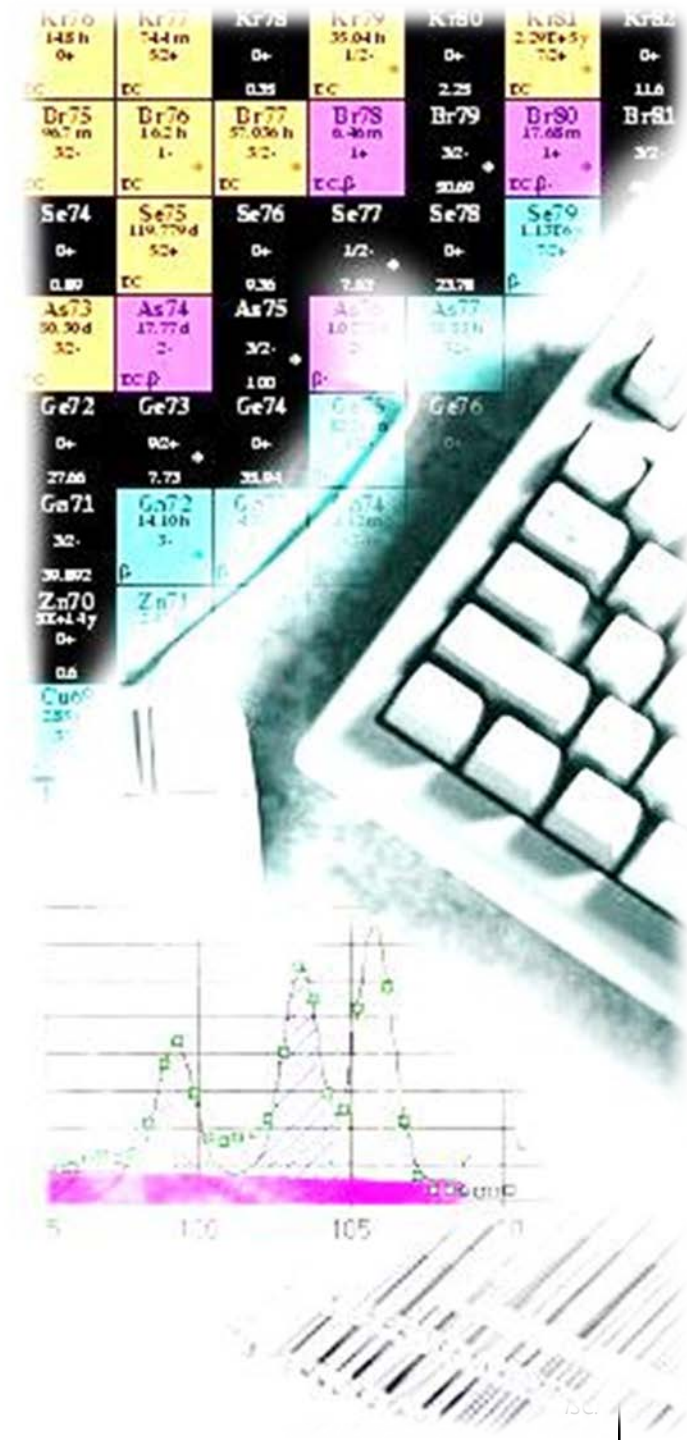
# LIMS at LRM Laboratory: activity measurements

Leen Verheyen – 18/01/2024

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# Contents

- Gamma ray spectroscopy lab at LRM
- What is a LIMS and why using it
- $\gamma$ -analysis process flow and management by LIMS
  - Sample registration
  - Spectrum acquisition
  - Analysis operations
    - Background correction
    - Efficiency transfer
    - Summing correction
    - Uncertainty budget
  - Reporting
  - Quality assurance: QC-QB- PTE's
  - Nuclide libraries
- Conclusions



# Gamma ray spectroscopy

20 HPGe detectors:

- BeGe >> Rel. eff. 38%
- ReGe >> Rel eff. 28 %
- Extended Range >> Rel eff. 50%
- Coaxial HPGe
- Ge(Li)
- LeGE
- Well HPGe

Rel. Eff. : 10-80 %

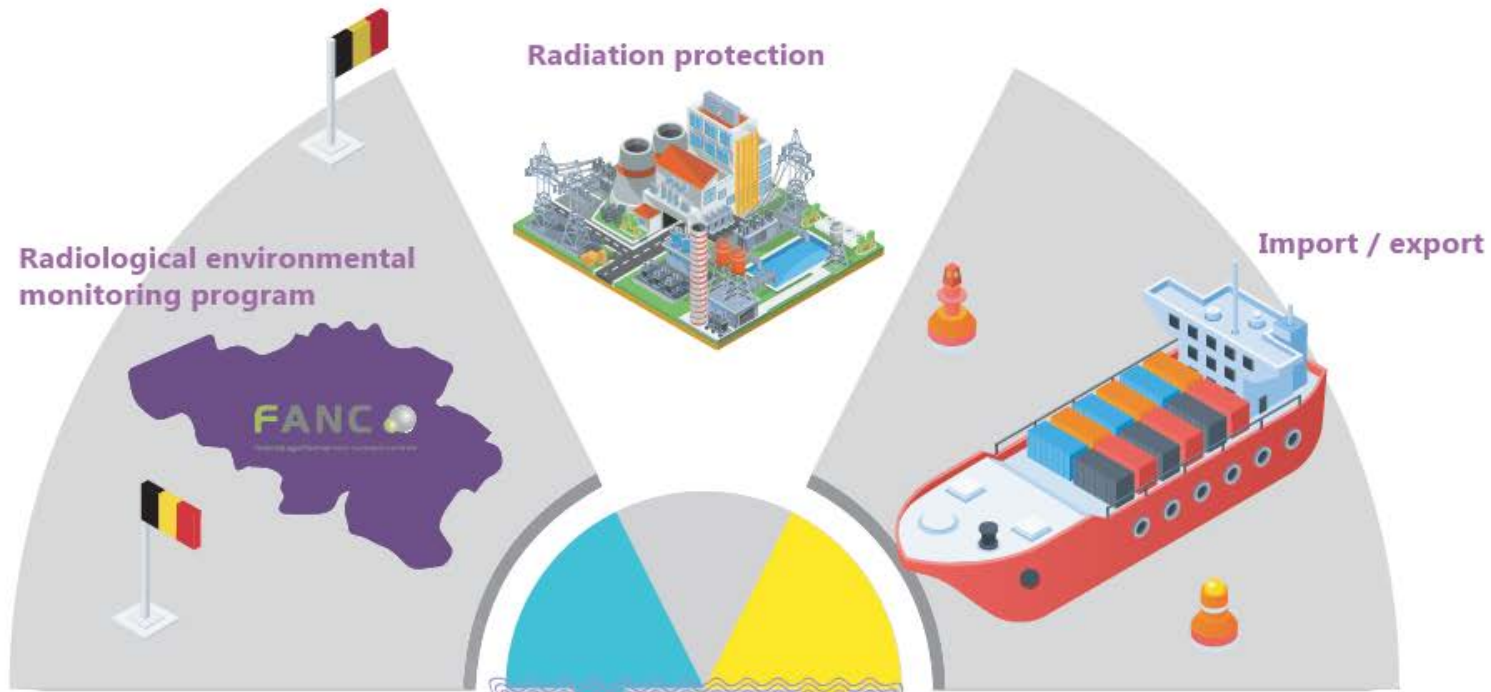
Digital signal analyzer LYNX (Mirion)

Liquid nitrogen:

Automated filling system

Weighing system under detector





**Radiological environmental monitoring program**



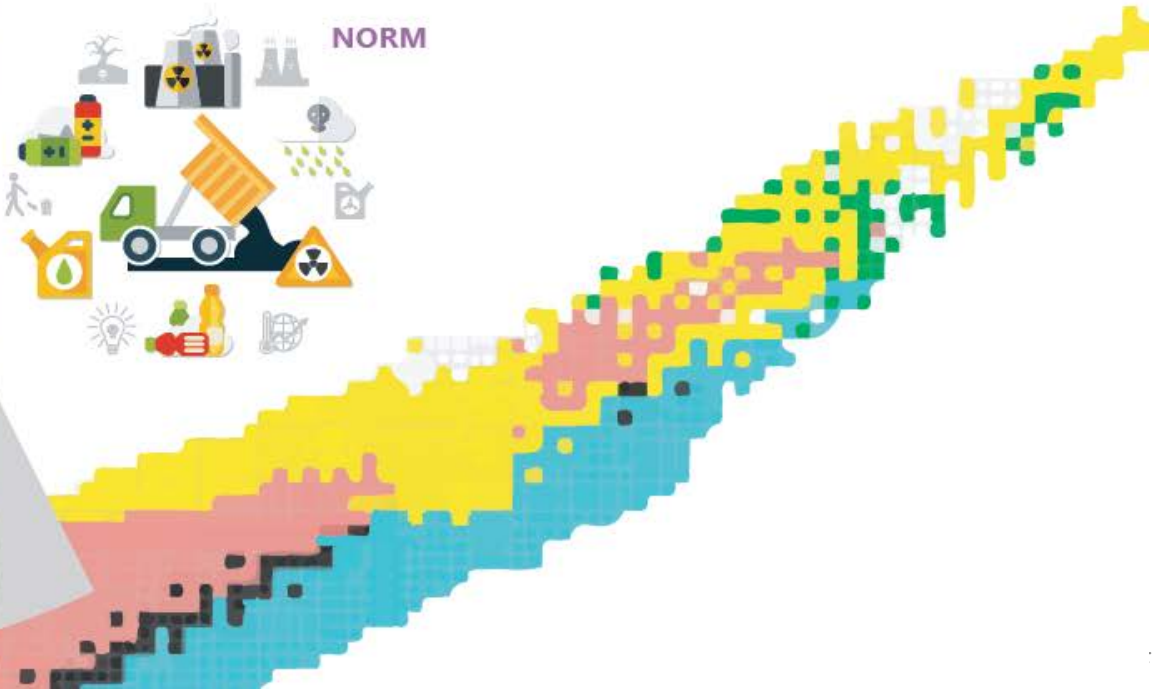
**Scientific research**



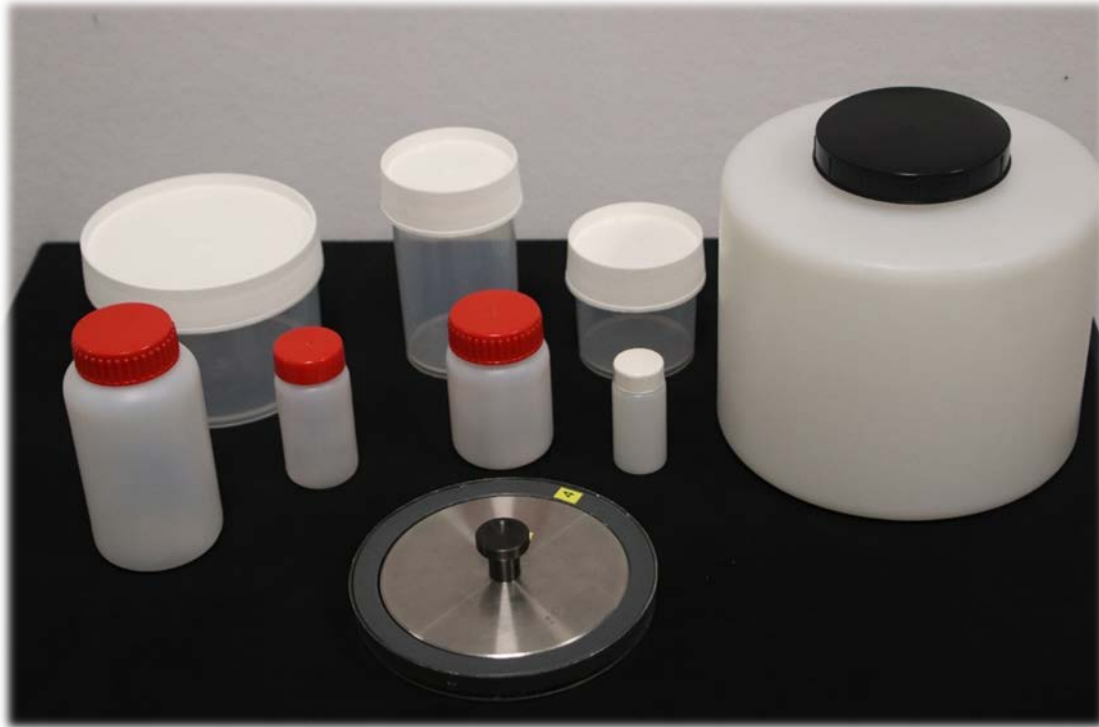
**NORM**



**Food control**



# Gamma ray spectroscopy @ LRM



- 3000-3500 samples/year
- Different geometries:
  - volumetrical, marinelli, cardriges, filters
- Weekly QA measurement
- Monthly background check
- ISO/IEC 17025 and ISO14001

## Calculations:

- GENIE2K
- EFFTRAN
  - Efficiency transfer
  - Summing correction

# What is a LIMS and why using it ?

## Laboratory Information and Management System



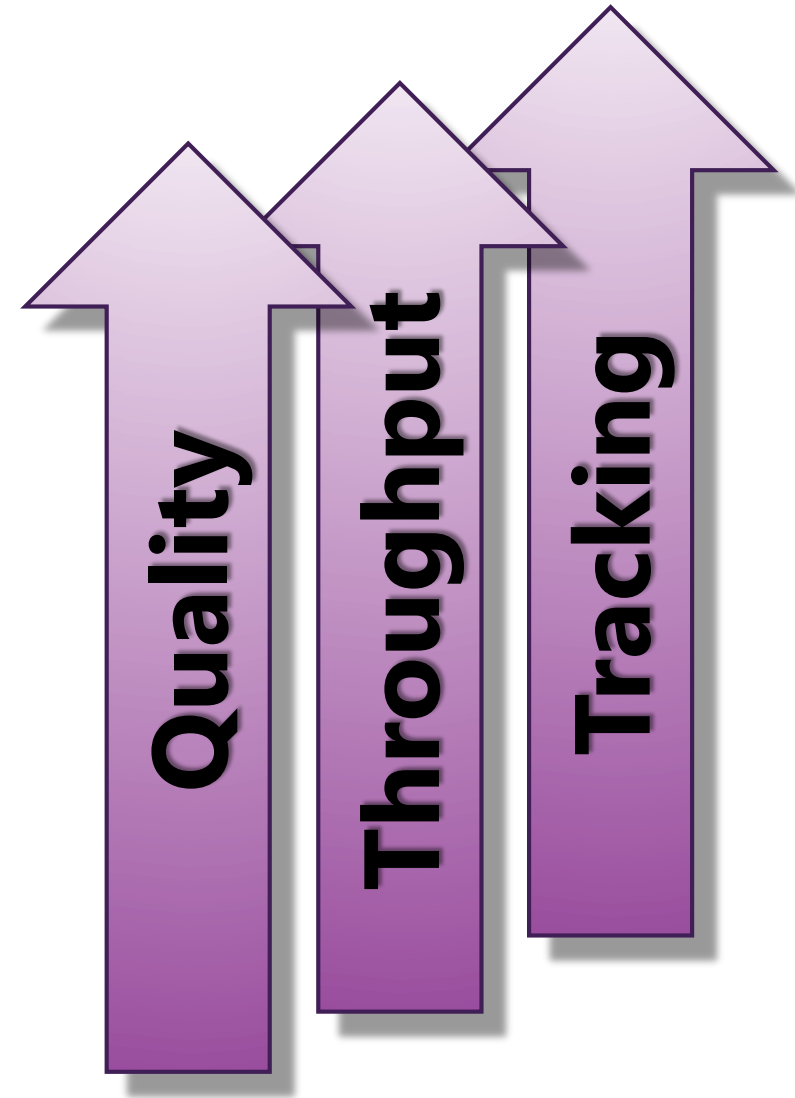
Is software-based laboratory and information management system that offers a set of key features that support a modern laboratory's operations. Those key features include:

- workflow;
- data tracking support;
- flexible architecture;
- smart data exchange interfaces;

That fully "support its use in regulated environments."

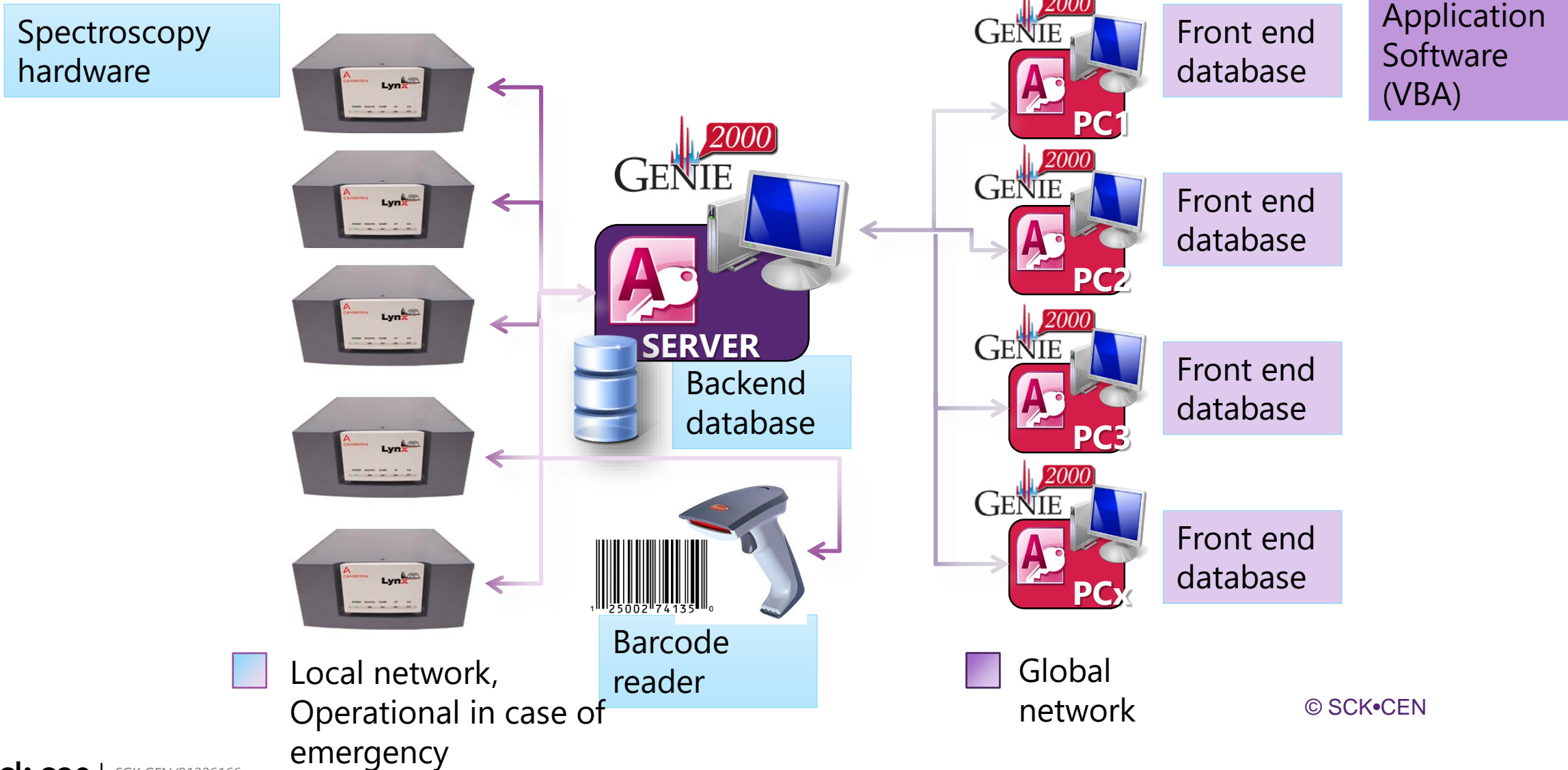
# Why using a LIMS ?

- Automation of analysis process (**Interfacing**)
  - Reducing user input
    - Spectrum management
    - Selection of Efficiency calibration
    - Selection of Background file
    - Selection of analysis parameters
- Increased throughput
- Improved quality
  - Same process for all analysis
- Data management (**Tracking**)
  - Calibrations
  - Spectra - analysis
  - QA data
  - Hardware Inventory
  - Reports & certificates
  - ...



# γLIMS architecture

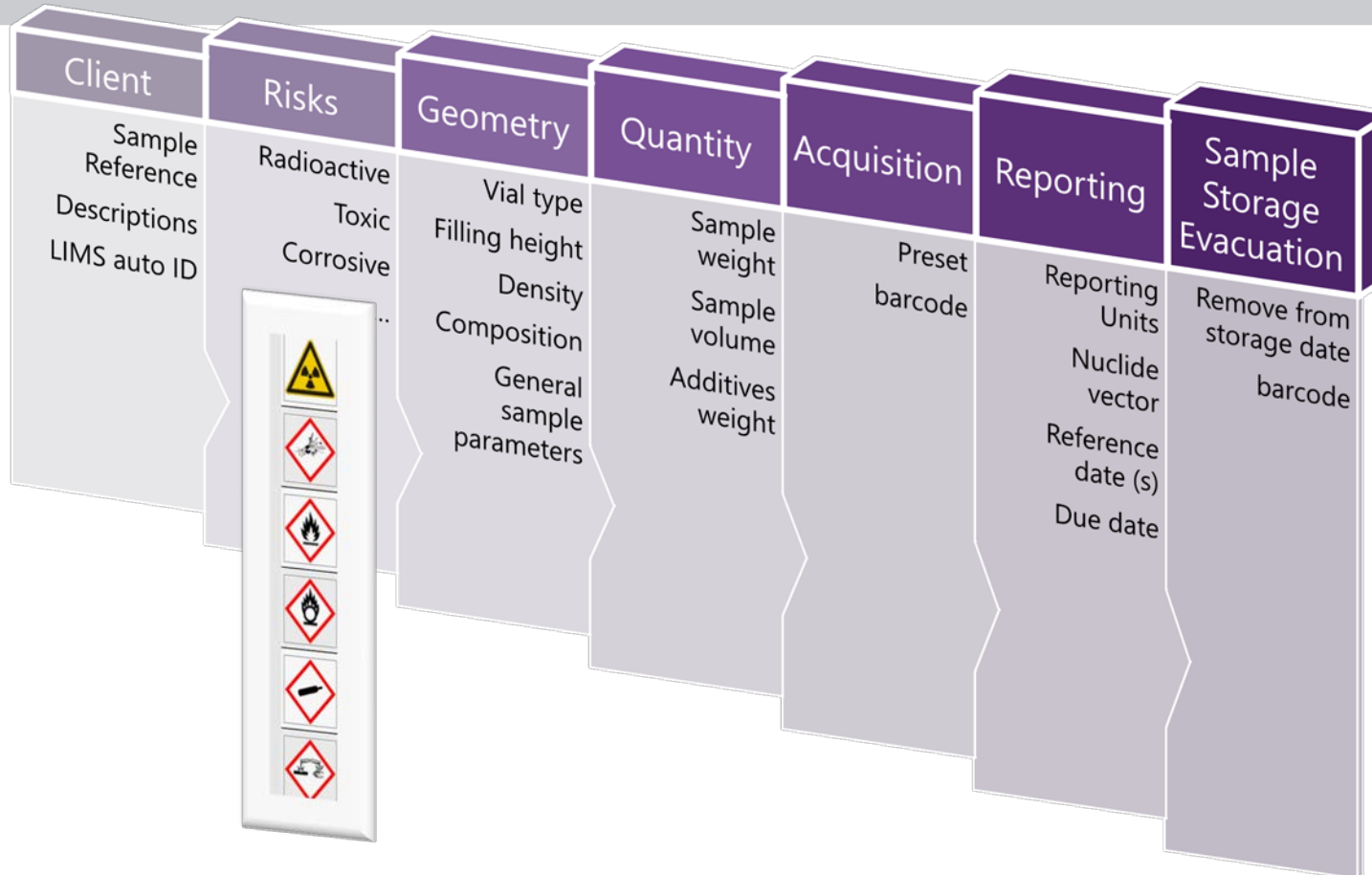
homemade based on MS Access – interfacing





# Sample registration

Sample reception    automatic client confirmation





# Sample registration

**ORDER ID** **20386** Confirmation Date   
**C\_LIMS\_ID:**

---

**Reception date**  **Order\_status:** ■ **Firm / CC or WBS**   
**Reference**  **Contact name**   
**Order Comment:**  **CC or WBS**

**O/O/2230020386**

 **Print Order Barcode**
 **Print LAB Sheet**

---

**Sample ID** **46304** 1 of 1  
**C-LIMS ID**  **Copy Previous**  
**Sample status:** ■ **Sample Ref**

Buildup None  Deposition  Irradiation  
**Sample Collection Start Date**   
**Sample Collection Stop Date**   
**Sample Ref Date :**   
**Sample Collector :**

mBq  Bq  kBq  
**Nuclide Vector :**   
**Sample has Certificate**  **# additional certificates:**

**Vial Type :**   
**Matrix Name :**

Sample Parameters	VALUE	ERROR	UNIT
Sample net weight / error	302.98	0.00	(g)
Sample height:	64.28	0.00	(mm)
Additive weight / error	0.00	0.00	(g)
Sample Density / error	0.54	0.00	(g/cm <sup>3</sup> )
Sample quantity / error	<input type="text" value="0.30"/> <input type="text" value="C"/>	0.00	<input type="text" value="kg"/>


**Report due date :**  +0 +3 +10 +28  
**Sample disposal date:**

**sample\_risk\_code:**   
**sample\_analysis\_code:**

**Type :**

**Time Preset (s)**

**500463040020386**

 **Print Sample Barcode**

---

	Actual values:	Reference values:	Difference (%):
<b>Filling height (mm):</b>	58.68	52.80	10.02
<b>Sample Material:</b>	Dirt1	water	DIFFERENT
<b>Sample Density: (g/cm<sup>3</sup>)</b>	0.54	1.03	-89.51
<b>Container Diameter: (mm)</b>	113.98	113.98	0.00
<b>Container Bottom Thickness: (mm)</b>	1.80	1.80	0.00
<b>Container Side Wall: (mm)</b>	2.00	2.00	0.00
<b>Container Material:</b>	Polypropyleen	Polypropyleen	EQUAL
<b>Container Density: (g/cm<sup>3</sup>)</b>	0.91	0.91	0.00
<b>Container Gap: (mm)</b>	3.80	3.80	0.00

**Requires Efficiency transfert**   
**Random Error (%):**   
**Systematic Error (%):**   
**Use fixed Value**   
**Computed Volume (mL)**   
**Reference Volume (mL)**   
**Filling height / error**



# Automated acquisition via barcode




Acquisition



Detector



1 25002 74135 0



Sample



1 25002 74135 0

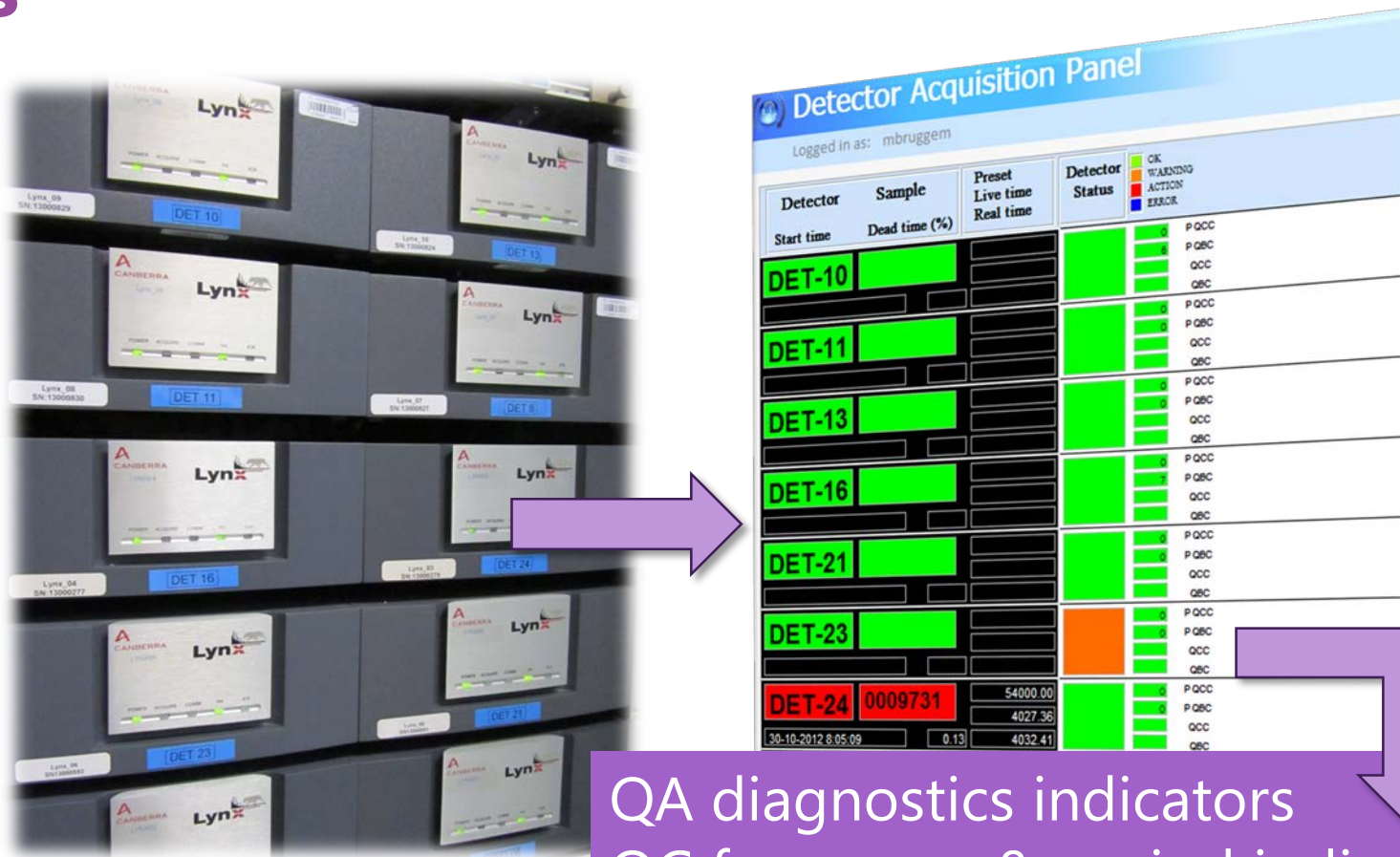


LIMS  
data



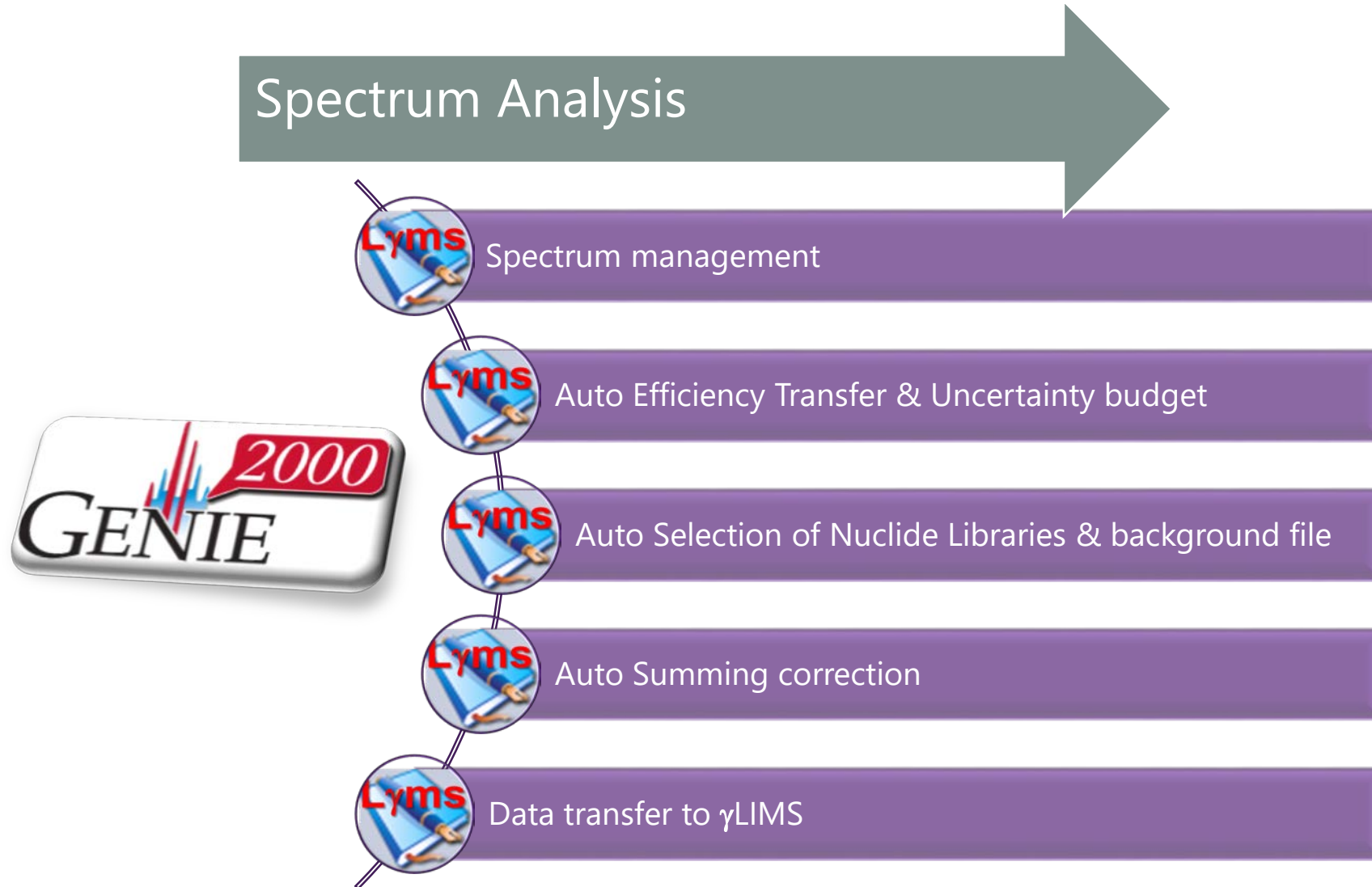
(Sample,Detector) couple  
Start – Stop commands  
Via barcode reader

# Acquisition dashboard with QC functions visible on all PCs



QA diagnostics indicators  
QC frequency & period indicators  
Status (OK, Warning, Action)

# $\gamma$ -LIMS control of Analyses



# $\gamma$ -LIMS management of spectra

Analyse Spectra With Genie2K

Query measurements using options

Measured    Date between 2012-10-20 And 2012-10-30  
 Analysed  
 Approved  
 Rejected

-1 week    Now - 1w    +1 week

Lookup in ORDERS  
 Lookup in SAMPLES

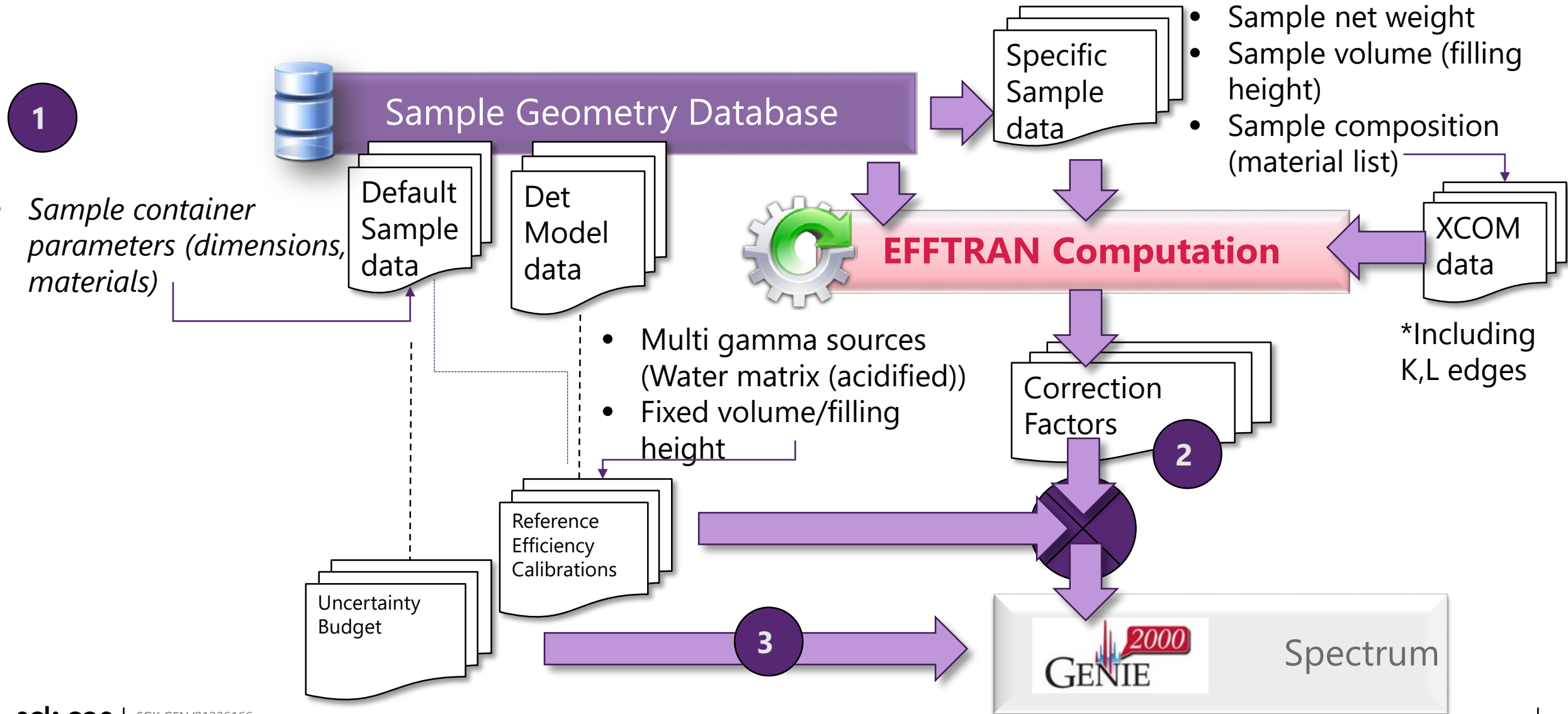
Show Datasheet View  
 Show Transfer Diagnostics Report

<input type="checkbox"/>	Order ID: 63 Sample ID: 88 Meas_type_ID: 4 Vial: Background Spectrum ID: 13729	Sample Title: BACKGROUND Company Name: SCK Backgroundmetingen Contact Name: M. Bruggeman Sample Description Meas_comment:	Spec. Name + No: 0000088m0381.CNF 381 Spectrum Path: G:\new\2008\August Detector ID: 16 Meas. Date/time: 29-10-2012 16:29:04	Measured <input checked="" type="checkbox"/> Analysed <input type="checkbox"/> Approved <input type="checkbox"/> Rejected <input type="checkbox"/>	
<input type="checkbox"/>	Order ID: 63 Sample ID: 88 Meas_type_ID: 4 Vial: Background Spectrum ID: 13730	Sample Title: BACKGROUND Company Name: SCK Backgroundmetingen Contact Name: M. Bruggeman Sample Description Meas_comment:	Spec. Name + No: 0000088m0382.CNF 382 Spectrum Path: G:\new\2008\August Detector ID: 10 Meas. Date/time: 29-10-2012 16:29:20	Measured <input checked="" type="checkbox"/> Analysed <input type="checkbox"/> Approved <input type="checkbox"/> Rejected <input type="checkbox"/>	
<input type="checkbox"/>	Order ID: 4887 Sample ID: 9524 Meas_type_ID: 6 Vial: 2500ml Marinelli Spectrum ID: 13722	Sample Title: 155080 staal 3 Company Name: SCK gammaspectrometrie Contact Name: Bruggeman Michel Sample Description: Sediment Aquafin Meas_comment:	Spec. Name + No: 0009524m0008.CNF 8 Spectrum Path: G:\new\2012\October Detector ID: 16 Meas. Date/time: 29-10-2012 7:52:27	Measured <input checked="" type="checkbox"/> Analysed <input type="checkbox"/> Approved <input type="checkbox"/> Rejected <input type="checkbox"/>	
<input type="checkbox"/>	Order ID: 4898 Sample ID: 9543 Meas_type_ID: 1 Vial: 250mL Spectrum ID: 13726	Sample Title: Gips 1 Company Name: Terranova NV Contact Name: Tom Maes Sample Description: Zone C1 Meas_comment:	Spec. Name + No: 0009543m0001.CNF 1 Spectrum Path: G:\new\2012\October Detector ID: 21 Meas. Date/time: 29-10-2012 16:14:02	Measured <input checked="" type="checkbox"/> Analysed <input type="checkbox"/> Approved <input type="checkbox"/> Rejected <input type="checkbox"/>	

Query spectra to be analysed

Click this button to load all data to the spectrum  
 Ref. efficiency + transfer  
 Background  
 Nuclide libraries

# Efficiency Transfer and Uncertainty Budget imported in Genie 2000



Gamma - 0046304m0000.CNF

File MCA Calibrate Display Analyze Edit Options Datasource Help

Idle Channel: 8192 : 2053.0 keV Counts: 1 Preset: 54000/54000.00

Acquire

Start Stop

Expand Off

Clear

ROI Index:

- +

Datasource

Prev Next

Script Engine Setup

Name of script component: SaveToDatabase.wsc Setup...

Cancel Help Select... Execute

VFS = 4K

TIME INFO

	Acq. Start:	18/09/2023 15:36:26	Elapsed	Preset
Next	Dead Time:	0.01%	Live (secs.): 54000.000	54000
Prev	Comp. Preset Region:		Real (secs.): 54005.850	0
	1 - 20 (channels)		Total (cnts.): 0.00	10





# Verify, Approve and/or Reject Analysis



Order	Sample	Sample_ID_client	Spec Name	Meas_date	D	A	P	R	A	R
20386	46304	SMN23008	0046304m0000.CNF	18/09/2023 15:36:26	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Record: 1 of 1 | No Filter | Search

**20386**

[Lookup Order](#)

[Lookup Sample](#)

Measured    Date between 2023-12-30 And 2024-01-09    **Requery**    **Sh**

Analysed

Approved

Rejected

Now - 1w  
+1 week  
-1 week

Company name: SCK•CEN - Gebouw EMI  
 CC - WBS - ext Client n°  
 Sample\_order\_ID: 20386  
 Order\_ref\_Client: SMN23008  
 Sample\_ID: 46304  
 Sample\_ID C-LIMS: 186820  
 Sample\_ID\_client: SMN23008  
 Sample Quantity (Unit): 0.30298 kg  
 Sample Weight (g): 302.98  
 Sample Density (g/cm³): 0.5435088  
 Additive Weight (g): 0  
 Sample Height (mm) / (%): 64.28 / 111.1364  
 Sample Geometry: 500 mL  
 Ref date:  
 Collection start date: 18/07/2023 12:00:00  
 Collection stop date: 16/08/2023 12:00:00  
 Vector Name: Gamma 2

Spectrum Name: 0046304m0000.CNF  
 Spectrum Path: G:\new\2023\August  
 Detector\_ID: 19  
 PRESET - LIVE - REAL(s): 54000 | 54000 | 54005.85  
 Dead Time (%): 1.083216E-02  
 Spectra.ID: 67028  
 Spectrum Discarded:   
 Status O - S:    
 Systematic Error: 0  
 Random Error: 0

Receptionist:  
 Order\_reception\_date: 17/08/2023  
 Measured On: 18/09/2023 15:36:26  
 Analysed by: Sylvia Spapen  
 Meas\_report\_edited:   
 Sample\_has\_Certificate:   
 add. certificates: 0  
 Analysis due date: 25/09/2023

**Approve**    **Reset**

Meas\_approved  
 on 19/09/2023 15:17:02  
 by: Leen Verheyen

[Update C-LIMS](#)

Peak Data    Detailed Nuclide Data    Final Results    Sample\_model

#	CENT	ENERGY	FWHM	SIGNIF	AREA	UNC	BACKG	NET AREA	UNC	EFF	Corr EFF	UNC	KNOWI	PEAKORIGII	PMNCLNAM
10	742.5	185.96	1.2	9.39	730.04	37.05	301.7	428.3	61.4	2.51E-02	2.51E-02	1.91E-03	<input checked="" type="checkbox"/>		
11	835.7	209.31	1.2	3.65	166.84	27.45	0.0	166.8	27.5	2.37E-02	2.37E-02	1.76E-03	<input checked="" type="checkbox"/>		
12	952.6	238.60	1.3	21.35	2172.43	52.20	73.0	2099.4	76.2	2.19E-02	2.19E-02	1.59E-03	<input checked="" type="checkbox"/>		
13	961.4	240.82	1.3	21.35	161.86	42.86	0.0	161.9	42.9	2.18E-02	2.18E-02	1.58E-03	<input type="checkbox"/>	Sum	
14	966.2	242.02	1.3	8.40	656.26	48.09	0.0	656.3	48.1	2.17E-02	2.17E-02	1.57E-03	<input checked="" type="checkbox"/>		
15	1079.6	270.43	1.3	4.50	197.77	25.09	13.0	184.8	37.2	2.01E-02	2.01E-02	1.43E-03	<input checked="" type="checkbox"/>		
16	1178.6	295.24	1.3	17.66	1393.30	41.63	9.0	1384.3	49.5	1.89E-02	1.89E-02	1.33E-03	<input checked="" type="checkbox"/>		
17	1198.2	300.16	1.3	4.20	177.72	23.13	0.0	177.7	23.1	1.86E-02	1.86E-02	1.31E-03	<input checked="" type="checkbox"/>		
18	1309.9	328.16	1.3	4.25	112.89	21.67	0.0	112.9	21.7	1.74E-02	1.74E-02	1.21E-03	<input checked="" type="checkbox"/>		
19	1350.4	338.30	1.3	9.08	471.54	28.65	24.0	447.6	36.3	1.70E-02	1.70E-02	1.18E-03	<input checked="" type="checkbox"/>		
20	1404.8	351.94	1.3	24.65	2427.60	51.33	91.5	2336.1	61.1	1.64E-02	1.64E-02	1.13E-03	<input checked="" type="checkbox"/>		
21	1847.0	462.77	1.4	5.03	163.07	19.53	0.0	163.1	19.5	1.31E-02	1.31E-02	8.69E-04	<input checked="" type="checkbox"/>		
22	1906.1	477.56	1.4	5.09	218.48	21.08	0.0	218.5	21.1	1.28E-02	1.28E-02	8.42E-04	<input checked="" type="checkbox"/>		

Record: 5 of 46 | No Filter | Search

# Verify, Approve and/or Reject Analysis

Order	Sample	Sample_ID_client	Spec Name	Meas_date	D	A	P	R	A	R
20386	46304	SMN23008	0046304m0000.CNF	18/09/2023 15:36:26	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Record: 14 | 1 of 1 | No Filter | Search

**20386**

Lookup Order

Lookup Sample

Measured  
 Analysed  
 Approved  
 Rejected

Date between 2023-12-30 And 2024-01-09

Requery Sh

Now - 1w  
+1 week  
-1 week

Company name: SCK•CEN - Gebouw EMI  
 CC - WBS - ext Client n°:  
 Sample\_order\_ID: 20386  
 Order\_ref\_Client: SMN23008  
 Sample.ID: 46304  
 Sample\_ID C-LIMS: 186820  
 Sample\_ID\_client: SMN23008  
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 Sample Weight (g): 302.98  
 Sample Density (g/cm³): 0.5435088  
 Additive Weight (g): 0  
 Sample Height (mm) / (%): 64.28 | 111.1364  
 Sample Geometry: 500 mL  
 Ref date:  
 Collection start date: 18/07/2023 12:00:00  
 Collection stop date: 16/08/2023 12:00:00  
 Vector Name: Gamma 2

Spectrum Name: 0046304m0000.CNF  
 Spectrum Path: G:\new\2023\August  
 Detector\_ID: 19  
 PRESET- LIVE- REAL(s): 54000 | 54000 | 54005.85  
 Dead Time (%): 1.083216E-02  
 Spectra.ID: 67028  
 Spectrum Discarded   
 Status O - S    
 Systematic Error: 0  
 Random Error: 0  
 Sample\_description\_1:  
 Sample\_description\_2:  
 Sample\_description\_3:  
 Sample\_description\_4:

Receptionist:  
 Order\_reception\_date: 17/08/2023  
 Measured On: 18/09/2023 15:36:26  
 Analysed by: Sylvia Spapen  
 Meas\_report\_edited   
 Sample\_has\_Certificate   
 add. certificates: 0  
 Analysis due date: 25/09/2023

Approve Reset

Meas\_approved on 19/09/2023 15:17:02 by: Leen Verheyen

Update C-LIMS

#	CENT	ENERGY	FWHM	SIGNI
10	742.5	185.96	1.2	
11	835.7	209.31	1.2	
12	952.6	238.60	1.3	2
13	961.4	240.82	1.3	2
14	966.2	242.02	1.3	
15	1079.6	270.43	1.3	
16	1178.6	295.24	1.3	1
17	1198.2	300.16	1.3	
18	1309.9	328.16	1.3	
19	1350.4	338.30	1.3	
20	1404.8	351.94	1.3	2
21	1847.0	462.77	1.4	
22	1906.1	477.56	1.4	

Record: 14 | 5 of 46 | No Filter | Search

#	Nuclid	CON	N-Energ	P-Energ	Delta	FWH	Yield(%)	Delta A	Mean Act	Act. Unc	Activity	MA Unc	Line MC	MDA	T1/2	UNIT
28	Bi-214*	0.78	665.45	665.78	-0.33	1.5	1.390909	1.4	2.56E+01	6.78E+00	3.56E+01	1.35E+00	3.65E+01	1.74E+00	5.05E+10	Y
4	Bi-214*	0.78	76.86	77.12	-0.26	1.2	0.426	5.7	2.56E+01	1.63E+02	9.58E+02	1.35E+00	2.68E+02	1.74E+00	5.05E+10	Y
40	Co-60	1.00	1332.49	1332.68	-0.19	1.8	95.76877	-0.2	7.26E-01	1.62E-01	6.91E-01	1.04E-01	6.99E-01	6.63E-01	1.66E+08	Y
38	Co-60	1.00	1173.23	1173.16	0.07	1.8	95.73346	0.1	7.26E-01	1.36E-01	7.52E-01	1.04E-01	6.63E-01	6.63E-01	1.66E+08	Y
27	Cs-137	1.00	661.66	661.67	-0.01	1.5	84.99	0.0	1.12E+01	7.62E-01	1.12E+01	7.62E-01	9.00E-01	9.00E-01	9.48E+08	Y
43	K-40	1.00	1460.82	1460.66	0.17	1.9	10.55	0.0	1.96E+02	1.07E+01	1.96E+02	1.07E+01	1.37E+01	1.37E+01	3.95E+16	Y
2	Pb-210	1.00	46.54	46.37	0.17	1.0	4.252	0.0	6.30E+01	3.85E+01	6.30E+01	3.85E+01	2.26E+02	2.26E+02	7.02E+08	Y
6	Pb-212*	1.00	90.08	89.91	0.17	1.1	1.77	2.7	1.37E+01	6.53E+00	3.15E+01	1.10E+00	3.15E+01	1.67E+00	6.04E+07	D
5	Pb-212*	1.00	87.35	87.14	0.21	1.1	5.77	1.4	1.37E+01	3.22E+00	1.86E+01	1.10E+00	9.74E+00	1.67E+00	6.04E+07	D
12	Pb-212*	1.00	238.63	238.60	0.03	1.3	43.6	0.2	1.37E+01	1.15E+00	1.41E+01	1.10E+00	1.67E+00	1.67E+00	6.04E+07	D
3	Pb-212*	1.00	74.82	74.83	-0.02	1.2	10.07	2.8	1.37E+01	5.03E+00	2.82E+01	1.10E+00	8.86E+00	1.67E+00	6.04E+07	D
17	Pb-212*	1.00	300.09	300.16	-0.07	1.3	3.057692	1.9	1.37E+01	3.10E+00	2.00E+01	1.10E+00	1.55E+01	1.67E+00	6.04E+07	D

Record: 14 | No Filter | Search



# Verify, Approve and/or Reject Analysis

Order	Sample	Sample_ID_cier	Spec Name	Meas_date	D	A	P	R	A	R
20386	46304	SMN23008	0046304m0000.CNF	18/09/2023 15:36:26	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

**20386**

Lookup Order

Lookup Sample

Measured    Date between 2023-12-30 And 2024-01-09    **Requery**

Analysed

Approved

Rejected

Company name: SCK•CEN - Gebouw EMI

CC - WBS - ext Client n°

Sample\_order\_ID: 20386

Order\_ref\_Client: SMN23008

Sample.ID: 46304

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Sample Quantity (Unit): 0.30298 kg

Sample Weight (g): 302.98

Sample Density (g/cm³): 0.5435088

Additive Weight (g): 0

Sample Height (mm) / (%): 64.28 / 111.1364

Sample Geometry: 500 mL

Ref date:

Collection start date: 18/07/2023 12:00:00

Collection stop date: 16/08/2023 12:00:00

Vector Name: Gamma 2

Spectrum Name: 0046304m0000.CNF

Spectrum Path: G:\new\2023\August

Detector\_ID: 19

PRESET - LIVE - REAL(s): 54000 | 54000 | 54005.85

Dead Time (%): 1.083216E-02

Spectra.ID: 67028

Spectrum Discarded

Status O - S

Systematic Error: 0

Random Error: 0

Sample\_description\_1:

Sample\_description\_2:

Sample\_description\_3:

Sample\_description\_4:

Receptionist:

Order\_reception\_date: 17/08/2023

Measured On: 18/09/2023 15:36:26

Analysed by: Sylvia Spapen

Meas\_report\_edited

Sample\_has\_Certificate

add. certificates: 0

Analysis due date: 25/09/2023

Peak Data    Detailed Nuclide Data    **Final Results**    Sample\_model

NUCLIDES ON REPORT

Nuclide	Activity	Unc (k=)	MDA	Unit
<b>Be-7</b>	18	4	11	Bq/kg
K-40	196	21	14	Bq/kg
Mn-54			0.9	Bq/kg
Co-57			0.8	Bq/kg
Co-58			1.1	Bq/kg
Co-60	0.73	0.21	0.7	Bq/kg
Zn-65			2.7	Bq/kg
Ag-110m			1.2	Bq/kg
I-131			38	Bq/kg
Cs-134			1.0	Bq/kg
Cs-137	11.2	1.5	0.9	Bq/kg

Allow EDIT

←

→

Rep. Tools

OTHER NUCLIDE DETECTED

Nuclide	Activity	Unc (k=2)
Tl-208*	5.6	0.9
Pb-210	60	80
Bi-212*	18	4
Pb-212*	13.7	2.2
Bi-214*	25.6	2.7
Pb-214*	24.1	2.6
Ra-226	29	10
Ac-228*	15.8	2.0

## Reporting Tools

Report

Nuclide	Activity	Uncert. k=2	MDA	Nuclide	Activity	Uncert. k=2	MDA	Check to report
K-40	196	21	14					
Th-234*				} U*-238				<input type="checkbox"/>
Pa-234m*					U*-235			
Ra-226	29	10	19	} Ra*-226	24.9	1.9	1.7	<input checked="" type="checkbox"/>
Bi-214*	25.6	2.7	1.7					
Pb-214*	24.1	2.6	2.0					
U-235				U*-235				<input type="checkbox"/>
Ac-228*	15.8	2.0	3.4	} Ra*-228	15.8	2.0	3.4	<input checked="" type="checkbox"/>
					Th*-232	15.8	2.0	3.4
Pb-212*	13.7	2.2	1.7	} Th*-228	15.8	1.7	1.7	<input checked="" type="checkbox"/>
Bi-212*	18	4	10					
Tl-208*	5.6	0.9	1.0					
Activity Index								
				0.227	0.014	0.027		
U enrichment (weight %)								
* assuming CU235 + CU238 = 100%								
Rh-106*				} Ru*-106				<input type="checkbox"/>
Th-227*					Ac*-227			

# Reporting



File Home Create External Data Database Tools Orders and Samples Spectrum Analysis Reporting Approval Quality Assurance Accountability LIMS Tools LIMS Management About Tell me what you want to do...

Reporting List Client Reporting for Excel PDF Reporting

Make PDF Report Read PDF Report Read PDF Certificate

Detector Acquisition Panel Approve Show\_spectra\_for\_report

Requery between +1 week Now - 1w 2023-12-30 And 2024-01-09 20386 Lookup for this ORDER Lookup for this SAMPLE

Approver Hulye Avci

Order	Sample	Sample ID by client	Spec Name	Report Path	Meas Date & Time	Firm Name	Contact Name	Cert.	Version	Multiple Report Selected	Report Consolidated data
20386	46304	SMN23008	0046304m0000.CNF	G:\pdf\2023\September\	18/09/2023 15:36:26	SCK CEN - Gebouw EME	Sneyers	<input type="checkbox"/>	0	<input type="checkbox"/>	<input type="checkbox"/>

Preview Report Edit Certificate Preview Certificate

# Reporting

- One report per sample > pdf
- One report per order > pdf
- Certificate creator > pdf
- Comment
- Version management
- Excel report per client per period
- emailing

Reporting List Client Reporting for Excel PDF Reporting

Make PDF Report Read PDF Report Read PDF Certificate

Detector Acquisition Panel Approve Show\_spectra\_for\_report

Requery between +1 week -1 week Now - 1w 2023-12-30 And 2024-01-09 20386

Lookup for this ORDER Lookup for this SAMPLE

Order	Sample	Sample ID by client	Spec Name	Report Path	Meas Date & Time	Firm Name
20386	46304	SMN23008	0046304m0000.CNF	G:\pdf\2023\September\	18/09/2023 15:36:26	SCK CEN - Gebc

# Reporting

- One report per sample > pdf
- One report per order > pdf
- Certificate creator > pdf
- Comment
- Version management
- Transfer results to: .xlsx, .xml formats
- emailing

Laboratory for Gamma Spectrometry  
 Boerstraat 200  
 B-2400 Mol  
 tel: +32 14 332828  
 gamma.spectrometrie@sckcen.be  
 http://go.app.sckcen.be/LRM

ISO/IEC 17025 Accredited Laboratory  
 Authorised Laboratory by FAVV  
 Member of IAE/As ALMERA Network

BVL  
 LAC  
 ISO 14001  
 CERTIFIED  
 N.015-TSTV

Stichting van Openbaar Nut - Fondation d'Utilité publique - Foundation of Public Utility

## Analysis Report

Report version: 0  
 Issue date & time: 9/01/2024 11:57:34

Liesel Snavers  
 SCK-CEN - Gebouw EME  
 Gebouw EME  
 2400 Mol  
 België

Your order reference:	SMN23008	Our Reference:	20386-46304-0
Your Sample Ref:	SMN23008	C-LIMS:	63962-186820
		Collection Start Date:	18/07/2023 12:00:00
		Collection Stop Date:	16/08/2023 12:00:00

### Sample Description

Nuclide	Activity	Uncert.	Unit	Nuclide	Activity	Uncert.	Unit
<sup>7</sup> Be	18	4	Bq/kg	<sup>40</sup> K	198	21	Bq/kg
<sup>54</sup> Mn	< 0.9		Bq/kg	<sup>57</sup> Co	< 0.8		Bq/kg
<sup>58</sup> Co	< 1.1		Bq/kg	<sup>60</sup> Co	0.73	0.21	Bq/kg
<sup>65</sup> Zn	< 2.7		Bq/kg	<sup>110m</sup> Ag	< 1.2		Bq/kg
<sup>131</sup> I	< 38		Bq/kg	<sup>134</sup> Cs	< 1.0		Bq/kg
<sup>137</sup> Cs	11.2	1.5	Bq/kg	<sup>226</sup> Ra*	24.9	1.9	Bq/kg
<sup>228</sup> Ra*	15.8	2.0	Bq/kg	<sup>228</sup> Th*	15.8	1.7	Bq/kg

Analysed By: Sylvia Spaepen  
 Approved by: Leen Verheyen

Analysis based on High Resolution Gamma-ray Spectroscopy using the laboratory specific method ML.LRM.0001.  
 All reported uncertainties refer to the expanded uncertainty (coverage factor of k=2), providing a level of confidence of approximately 95%.  
 \* The activity of nuclides labeled with this symbol are derived from the activity of daughter nuclides or related nuclides.  
 Detection limits are computed according to ISO 11929 with  $\alpha = 5\%$ .  
 This report shall not be reproduced except in full, without written approval of the laboratory. The results in this report relate only to the item tested. Unless otherwise specified, organic samples will be destroyed one week after reporting, others samples after one month.

sck cen Reporting in Dutch / in français Reporting template version 1.0 Page 1 of 1

Reporting List Client Reporting for Excel PDF Reporting

Make PDF Report Read PDF Report Read PDF Certificate

Detector Acquisition Panel Approve Show\_spectra\_for\_report

Requery between +1 week Now - 1w 2023-12-30 And 2024-01-09 20386 Lookup for this ORDER Approver

Order	Sample	Sample ID by client	Spec Name
20386	46304	SMN23008	0046304m0000.CNF

# Reporting

- One report per sample
- One report per order
- Certificate creator > p
- Comment
- Version management
- Excel report per client
- emailing

Analysis Reports/Certificates with ref.: SMN23008 - Message (HTML)

File Message Insert Options Format Text Review Acrobat Tell me what you want to do...

Clipboard Basic Text Names Include Tags OpenText

From: spectro@SCKCEN.BE

To: laboM&M@sckcen.be

Cc:

Bcc:

Subject: Analysis Reports/Certificates with ref.: SMN23008

Attached: REP\_0046304m0000.pdf 165 KB

Use Adobe Send & Track Yes No

Gechte klant,

Gelieve in bijlage analyse rapporten te willen vinden met bovenstaande referenties. De originele documenten worden met normale post verstuurd. Certificaten worden pas doorgestuurd na Uw goedkeuring te hebben ontvangen.

Wij hechten veel belang aan de tevredenheid van onze klanten, vul daarom zeker onze enquête in om onze diensten te beoordelen, ze is beschikbaar via de onderstaande link:

[Naar onze enquête!](#)

Vriendelijke Groeten

Het Labo Gammaspectrometrie

Cher client,

Veuillez trouver ci joint les rapports d'analyse spécifiés ci-dessus. Les documents originaux seront envoyer par courrier. Les certificats ne seront envoyés qu'après avoir reçu votre accord.

Nous attachons une grande importance à la satisfaction de nos clients. Nous vous encourageons donc vivement à remplir notre enquête pour évaluer nos services. Elle est disponible via le lien ci-dessous:

[Vers l'enquête!](#)

Cordialement

Le Labo Gammaspectrométrie

# Query Client Specific Results

# Export to excel

From  Till   
 Firm\_SCK\_number

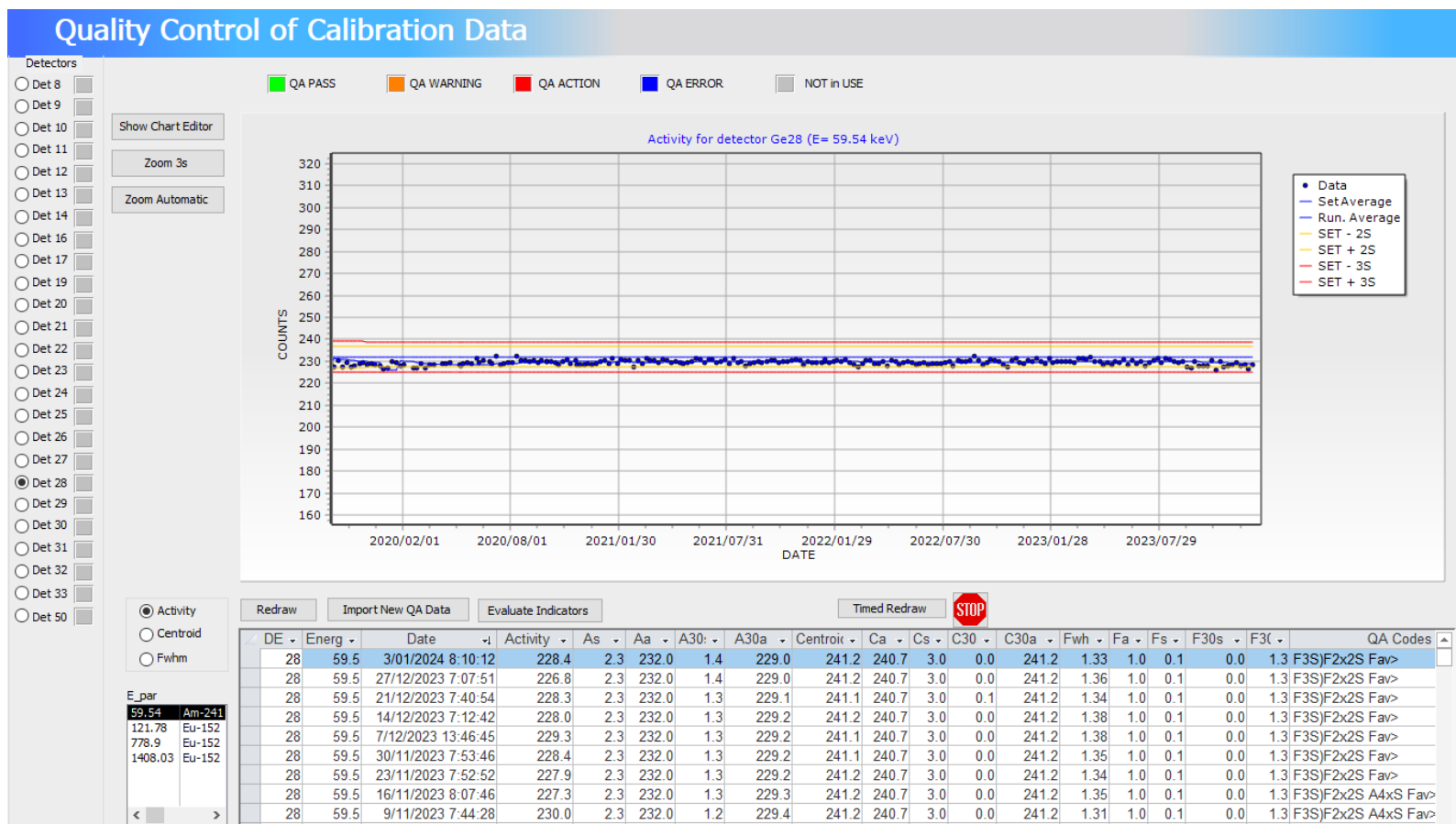
Export to Excel

Order_WBS_↕	Lab ID	Sample ID clie	coll. start date	coll. stop date	ref date	NUCLIDE	Less Than	ACTIVITY	UNC(k=2)	Unit	Approval Date ↕	S
ESURV2124-23	47682	WMN23351364	18/12/2023 12:00:00	31/12/2023 12:00:00		Be-7	< 0.6			Bq/L	8/01/2024 12:21:15	
ESURV2124-23	47682	WMN23351364	18/12/2023 12:00:00	31/12/2023 12:00:00		K-40	< 1.1			Bq/L	8/01/2024 12:21:15	
ESURV2124-23	47682	WMN23351364	18/12/2023 12:00:00	31/12/2023 12:00:00		Se-75	< 0.09			Bq/L	8/01/2024 12:21:15	
ESURV2124-23	47682	WMN23351364	18/12/2023 12:00:00	31/12/2023 12:00:00		Nb-95	< 0.08			Bq/L	8/01/2024 12:21:15	
ESURV2124-23	47682	WMN23351364	18/12/2023 12:00:00	31/12/2023 12:00:00		Zr-95	< 0.13			Bq/L	8/01/2024 12:21:15	
ESURV2124-23	47682	WMN23351364	18/12/2023 12:00:00	31/12/2023 12:00:00		Ru-103	< 0.08			Bq/L	8/01/2024 12:21:15	
ESURV2124-23	47682	WMN23351364	18/12/2023 12:00:00	31/12/2023 12:00:00		I-131	< 0.16			Bq/L	8/01/2024 12:21:15	
ESURV2124-23	47682	WMN23351364	18/12/2023 12:00:00	31/12/2023 12:00:00		Cs-134	< 0.07			Bq/L	8/01/2024 12:21:15	
ESURV2124-23	47682	WMN23351364	18/12/2023 12:00:00	31/12/2023 12:00:00		Cs-137	< 0.08			Bq/L	8/01/2024 12:21:15	
ESURV2124-23	47682	WMN23351364	18/12/2023 12:00:00	31/12/2023 12:00:00		Ce-141	< 0.14			Bq/L	8/01/2024 12:21:15	
ESURV2124-23	47682	WMN23351364	18/12/2023 12:00:00	31/12/2023 12:00:00		Ce-144	< 0.5			Bq/L	8/01/2024 12:21:15	
ESURV2124-23	47682	WMN23351364	18/12/2023 12:00:00	31/12/2023 12:00:00		Ru*-106	< 0.6			Bq/L	8/01/2024 12:21:15	
ESURV2124-23	47683	WDS23351364	19/12/2023 12:00:00	1/01/2024 12:00:00		Be-7	< 1.6			Bq/L	8/01/2024 12:27:37	
ESURV2124-23	47683	WDS23351364	19/12/2023 12:00:00	1/01/2024 12:00:00		K-40	< 2.8			Bq/L	8/01/2024 12:27:37	
ESURV2124-23	47683	WDS23351364	19/12/2023 12:00:00	1/01/2024 12:00:00		Se-75	< 0.21			Bq/L	8/01/2024 12:27:37	
ESURV2124-23	47683	WDS23351364	19/12/2023 12:00:00	1/01/2024 12:00:00		Nb-95	< 0.19			Bq/L	8/01/2024 12:27:37	
ESURV2124-23	47683	WDS23351364	19/12/2023 12:00:00	1/01/2024 12:00:00		Zr-95	< 0.34			Bq/L	8/01/2024 12:27:37	
ESURV2124-23	47683	WDS23351364	19/12/2023 12:00:00	1/01/2024 12:00:00		Ru-103	< 0.20			Bq/L	8/01/2024 12:27:37	
ESURV2124-23	47683	WDS23351364	19/12/2023 12:00:00	1/01/2024 12:00:00		I-131	< 0.39			Bq/L	8/01/2024 12:27:37	
ESURV2124-23	47683	WDS23351364	19/12/2023 12:00:00	1/01/2024 12:00:00		Cs-134	< 0.16			Bq/L	8/01/2024 12:27:37	
ESURV2124-23	47683	WDS23351364	19/12/2023 12:00:00	1/01/2024 12:00:00		Cs-137	< 0.18			Bq/L	8/01/2024 12:27:37	
ESURV2124-23	47683	WDS23351364	19/12/2023 12:00:00	1/01/2024 12:00:00		Ce-141	< 0.28			Bq/L	8/01/2024 12:27:37	
ESURV2124-23	47683	WDS23351364	19/12/2023 12:00:00	1/01/2024 12:00:00		Ce-144	< 1.1			Bq/L	8/01/2024 12:27:37	
ESURV2124-23	47683	WDS23351364	19/12/2023 12:00:00	1/01/2024 12:00:00		Ra*-228	< 0.6			Bq/L	8/01/2024 12:27:37	
ESURV2124-23	47683	WDS23351364	19/12/2023 12:00:00	1/01/2024 12:00:00		Th*-232	< 0.6			Bq/L	8/01/2024 12:27:37	

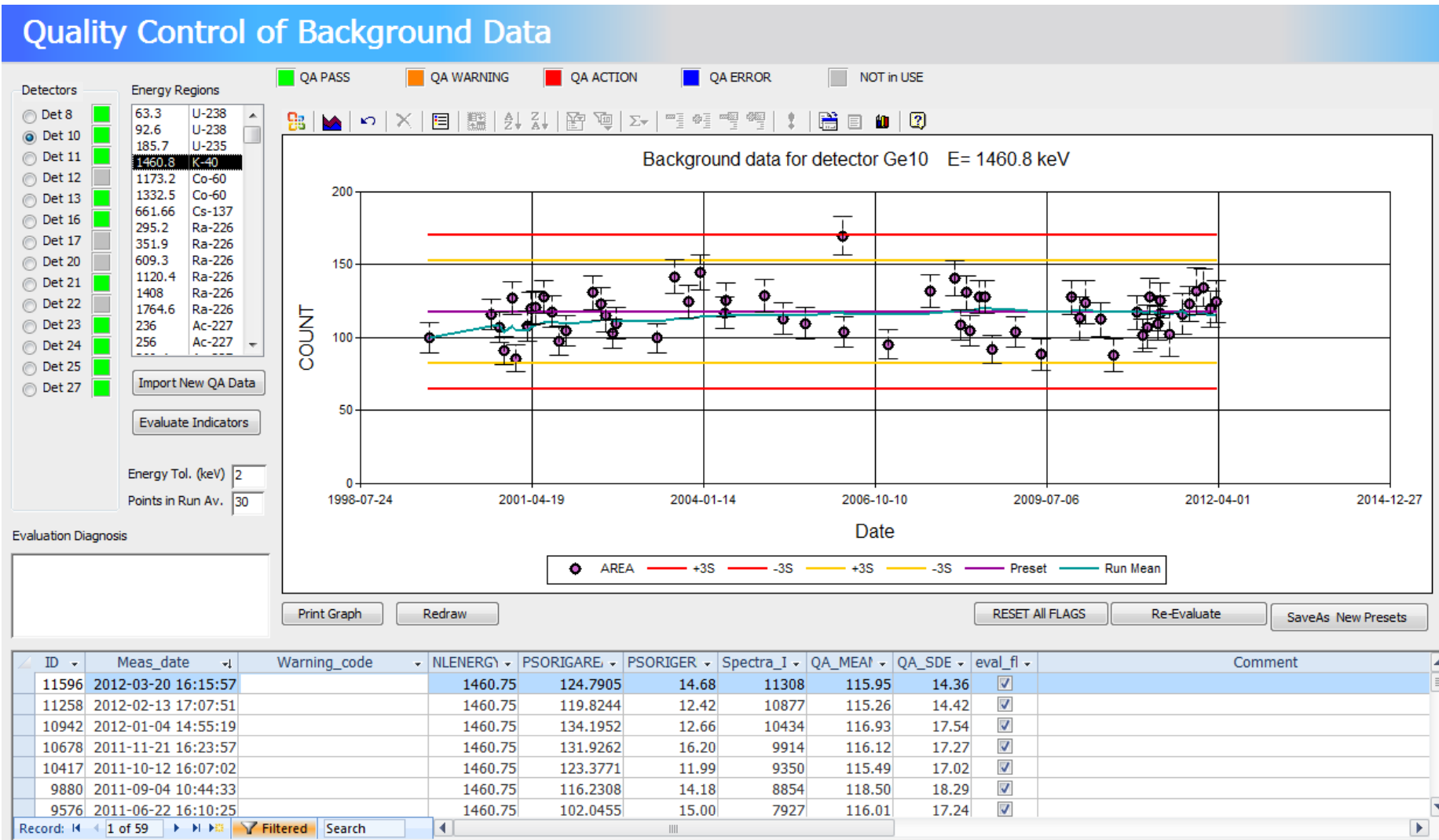


# Quality assurance

- Quality control check
  - > QCC
- Quality Background check
  - > QBC
- Proficiency Testing



# Background correction (ex. K-40)



# Registration and evaluation of Proficiency tests

## Proficiency Tests Results

IAEA

Proficiency Organiser:

Test Name:

Test date:

Lab. Number Assigned:

Test Completed:

Report\_option

Proficiency Data Only

Second Line Only

All Results

Sample ID:

Nuclide	Test_extern	Our Result	Our Unc.(k=2)	Target Value	T. Unc.(k=2)	Unit	z-Score	Matrix	Sample ID	Spectrum_ref	Dete	Sample_ID_test
Co-60	<input checked="" type="checkbox"/>	18	1.3	17.7	2.2	Bq / kg	0.2	water	42134	60775	DET-25	01 spiked water
Pb-210	<input checked="" type="checkbox"/>	31	7	31.3	3.8	Bq / kg	-0.1	water	42134	60775	DET-25	01 spiked water
Cs-134	<input checked="" type="checkbox"/>	15.7	1.3	15.9	2	Bq / kg	-0.2	water	42134	60775	DET-25	01 spiked water
Cs-137	<input checked="" type="checkbox"/>	23.6	2.8	24.2	3	Bq / kg	-0.3	water	42134	60775	DET-25	01 spiked water
Am-241	<input checked="" type="checkbox"/>	10.5	2.1	10.1	1.2	Bq / kg	0.3	water	42135	60806	DET-30	02 Spiked water
Cs-137	<input checked="" type="checkbox"/>	8.1	1	8.36	1	Bq / kg	-0.4	water	42135	60806	DET-30	02 Spiked water
Cs-137	<input checked="" type="checkbox"/>	22.9	2.7	22.6	2.8	Bq / kg	0.2	water	42136	60804	DET-31	03 Spiked water
Cs-134	<input checked="" type="checkbox"/>	12	1	12.1	1.4	Bq / kg	-0.1	water	42136	60804	DET-31	03 Spiked water

# Use of recommended nuclear data [www.nucleide.org](http://www.nucleide.org)

A periodic table of elements with a blue border. The elements are arranged in their standard periodic layout, including the lanthanide and actinide series at the bottom.

Trier par :

Nuclide	Z	Vol. (?)	UpDate	Type (?)	Table (?)	Comments (?)	ASCII files (?)	
Ac-225	<sup>225</sup> Ac	89	9	20/12/2023	3	T	C	E P L
Ac-227	<sup>227</sup> Ac	89	4	16/02/2009	2	T	C	E P L B
Ac-228	<sup>228</sup> Ac	89	6	22/01/2010	3	T	C	E P L B
Ag-108	<sup>108</sup> Ag	47	3	04/09/2006	2	T	C	E P L B

# Use of recommended nuclear data www.nucleide.org

Recommended data  
www.nucleide.org

Nuclide Library for Genie2K

The screenshot shows the GENIE Nuclide Search interface. The main display shows the nuclide **Th-234** with a half-life of **24.1000** and a decay mode of **0.030 Y**. Below this, there are input fields for various parameters such as Nuclide Type, Abundance Limit, MDA to be met, Mass Factor, Equivalence Factor, Average Gamma, Average Beta, Parent Nuclide, Decay Ratio, and Unc. Decay Ratio.

To the right, a table displays decay data for Th-234. The table has columns for Energy (E), Uncertainty in Energy (unc E), Intensity (I), Uncertainty in Intensity (unc I), and other parameters. The first row is highlighted in green.

E (keV)	unc E (keV)	I (%)	unc I (%)	ray_type	updated_on
15.7401	0	7.1	0.3	XL	
62.88	0.02	0.0164	0.0028	g	
63.3	0.02	3.75	0.08	g	
73.92	0.02	0.0133	0.0014	g	
83.31	0.05	0.061	0.005	g	
92.288	0	0.013	0.009	XKa2	
92.38	0.01	2.18	0.19	g	
92.8	0.02	2.15	0.19	g	
95.869	0	0.021	0.013	XKa1	
112.81	0.05	0.215	0.022	g	



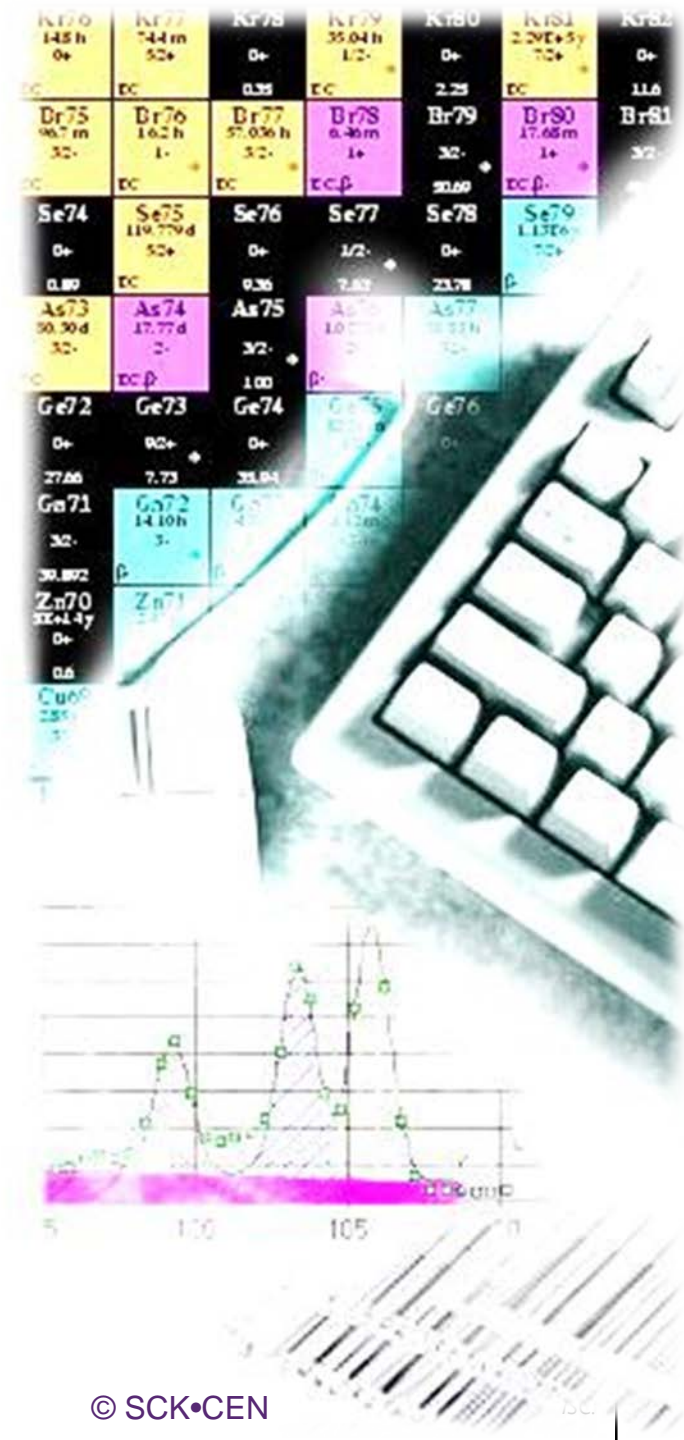
Nuclear data management

# Conclusions

A LIMS will improve your analysis process and work efficiency

- Automation via dedicated interfacing
  - Minimises human blunders in data treatment
  - Assures a same level of quality for all samples treated
  - Contributes to confidence based on diagnostics and easy verification options
  - Increases throughput
  - Simplifies methods (instructions)
  - Easier training of new operators
  - Offers more flexibility (continuity in process by different operators)
- Easy data tracking options
- Communication with customers (ISO 17025)

All functionality needs to be validated





Any questions, ideas, ...

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### **SCK CEN**

Belgian Nuclear Research Centre

Foundation of Public Utility

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