GEORADIS

RT-50

Laboratory gamma ray spectrum analyzer with evaluation program

LabCenter

User Manual

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for Windows 10, 11

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Laboratory gamma ray

spectrum analyser

RT-50

with evaluation program

LabCenter

Production and service:
GEORADIS s.r.o.
Novomoravanská 321/41
619 00 Brno
Czech Republic

Phone: +420 541 422 231
E-mail: info@georadis.com
Web: www.georadis.com

Content

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I. Introduction

The **RT-50** laboratory spectrometer is a 1024 channel gamma-ray spectrometer with a cylindrical NaI/Tl (Sodium Iodide) scintillation detector (3"diameter x 3" height), enclosed in heavy lead shielding with a minimum wall thickness of 3.5 inches (9 cms). A specially designed lid permits easy sample loading and removal. The analyzer unit has an integrated high voltage supply, amplifier, analog - digital converter plugged directly onto the detector socket. The RT-50 spectrometer unit operates under the control of the system computer (PC) via USB cable. The USB cable also supplies all necessary power to the unit.

1.1.   APPLICATION RANGE OF THE RT-50

RT-50 is controlled from a standard PC using the **LabCenter** software program. The **LabCenter program** calculates from measured gamma spectra concentrations of natural radioactive elements K-40, U (natural) and Th (natural) or the activities of man-made elements - typically Cs-137, Co-60 and Am-241. The range of tested elements can be extended by the use of suitable calibration standards.

Correct activity computation requires geometrical conformity with the calibration standards. Size, mass, material and even the positioning of the sample in the detector should be as similar as possible as those of the calibration samples to achieve the best results and optimize system performance. A description of the basic supplied standards can be found in chapter 4.2.

Use of heavy lead shielding (9 cm wall thickness) allows the RT-50 to reach very low level detection limits of various radionuclides. The lid of the measuring chamber must be kept closed during the measurement process.

The LabCenter program allows the user to set activity limits for individual radionuclides, or, according to the circumstances, various combined limits for mixtures of radionuclides, and subsequently automatically evaluate cases of exceeding the limits. See Chapter 3.3.5.

1.2.   PREPARATION OF SAMPLES

Preparation of steel samples does not require any special procedures. The steel calibration standards are designed to copy the typical geometries of samples commonly used in the steel industry. The sample temperature must respond to the detector temperature which means it must be equal to ambient room temperature.

Dust and slag samples must be milled and homogenized in suitable measuring cans which must have a size similar to those of the dust calibration samples. The weight of the sample should also be similar to the weight of the calibration sample and within +/- 30 %. Measuring containers that are repeatedly used should be carefully cleaned after each use to make sure there is no cross contamination of the measurement sample.

1.3.   LIMITS OF DETECTION

Sensitivity of measurement – detection limit is influenced by several factors. In addition to geometrical factors (shape of sample) the weight of the sample and measurement time are also important.

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The following table gives the detection limits for most typical samples and measurement times.

Laboratory spectrometer RT-50
produced by GEORADIS Brno, CZ

Detection limits for the selected radionuclides – etalons TS11 (100 ml / 120 g)							
Time of meas	Cs-137	K		U eq.		Th eq.	
300 s	5 Bq	35 Bq	1,0 %	5 Bq	3,0 ppm	5 Bq	3,0 ppm
900 s	3 Bq	22 Bq	0,6 %	3 Bq	2,0 ppm	3 Bq	2,0 ppm
1800 s	2 Bq	15 Bq	0,4 %	2 Bq	1,3 ppm	2 Bq	1,3 ppm
3600 s	1.4 Bq	10 Bq	0,3 %	1.4 Bq	1,0 ppm	1.4 Bq	1,0 ppm

Detection limits for the selected radionuclides – etalons G250 (250 ml / 400 g)							
Time of meas	Cs-137	K		U eq.		Th eq.	
300 s	8 Bq	60 Bq	0,5 %	8 Bq	1,5 ppm	8 Bq	1,5 ppm
900 s	5 Bq	35 Bq	0,3 %	5 Bq	1,0 ppm	5 Bq	1,0 ppm
1800 s	3.5 Bq	25 Bq	0,2 %	3.5 Bq	0,7 ppm	3.5 Bq	0,7 ppm
3600 s	2.5 Bq	20 Bq	0,15 %	2.5 Bq	0,5 ppm	2.5 Bq	0,5 ppm

Detection limits are calculated for radionuclides and methods supplied by manufacturer. The following formula can be used to determine limits in different conditions.

$$DL_{vz} = DL_{et} * m_{vz} / m_{et}$$

DL_{vz} sample detection limit,

DL_{et} detection limit of the standard,

m_{et} calibration standard weight

m_{vz} sample weight .

$$DL_t = DL_{st} * SQRT(t_{st} / t_t)$$

DL_t detection limit for new time of measurement,

DL_{st} detection limit for old time of measurement

t_{st} standard measuring time

t_t new measuring time.

2. Description of RT-50

The RT-50 is a compact instrument (see picture 2.1.) which is controlled from a standard PC via USB interface. The USB cable also supplies all operating power to the unit. The solid base of the instrument case supports heavy steel or lead shielding assembled from steel or lead rings. A sample chamber consisting of a thin aluminium container is inserted in the shielding. The sample chamber is covered with a massive movable steel or lead lid. Its sophisticated design allows easy single hand operation. Use of the handle guarantees safe operation of the lid. However the lid is very heavy and extreme caution should be used when operating the lid. The cabinet is coated with durable plastic for easy maintenance and cleaning. At the rear there is a USB cable. There are no other controlling or manipulating elements located on the instrument. The instrument is fully controlled from the system computer.

Picture 2.1

2.1. CONFIGURATION AND REQUIREMENTS

The RT-50 consists of following parts:

- Detector NaI(Tl) Ø 76 mm x 76 mm (3x3'') with integrated photomultiplier
- Multichannel gamma-ray spectrometer
- Steel or Lead shielding with movable lid
- Stabilization standard Cs-137 TEST SOURCE TS-9
- USB cable
- Installation USB flash for PC program **LabCenter**
- User's guide

Selectable options are:

- Marinelli adaptor for high sensitive measurement in Marinelli beakers
- Digital balances **RADWAG WPS 2100/R.2** with USB and RS-232 port
- PC and 22" LCD monitor
- Set of **STEEL** calibration standards **TS-8** (Co-60, background)
- Set of **DUST** calibration standards **TS-11** (volume 100 ml, K, U, Th, Cs, Co, Am, background) for dusts and slags
- Set of **BUILDINGS** calibration standards **TS-11** (volume 200 ml, K, Ra, Th, Cs, background) for building materials
- Set of **FOOD** calibration standards **TS-14** (volume 200 ml, Cs-134, Cs-137, K-40, background) for measurement of food contamination
- Set of **GEO** calibration standards **TS-15** (volume 200 ml, K, U, Th, Cs, background) for geophysical applications
- Set of **GEO** calibration standards **RG** (500 g, K, U, Th reference materials of IAEA) for geophysical applications
- Set of 200 ml containers (60 pcs)
- Set of 100 ml containers (100 pcs)
- Set of working etalons according to the previous items in Marinelli beakers 600 ml

The standard RT-50 system includes the digital balance and the suitable set of calibration standards. Customers have the option to supply their own PC with local service and language. The following are minimal requirements for a PC supplied by the customer.

- Processor Intel Core i3, 2.0 GHz or compatible
- RAM 8 GB
- Hard drive 200 GB
- 3 x USB port
- Microsoft Windows 10, 64 bit system

2.2.   MAINTENANCE

All functions of the RT-50 instrument (except sample changing) are controlled by software from PC. There is no control element located on the instrument.

The RT-50 is designed for simple maintenance but the user can take simple basic steps to ensure accurate measurement of samples. It is extremely important to keep the measuring area/sample chamber free of any potential contamination by radioactive elements. The guaranteed sensitivities depend on a minimal radiation background. We recommend that calibration standards and also the test samples are put in a suitable plastic bag before being placed in the sample chamber. It is much simpler to dispose of a contaminated bag than to perform a complicated decontamination of the measuring area/sample chamber.

The measured samples should be cleaned from the dust and steel samples should be cleaned from the free parts like mill scale or rust that could adhere on the surface of the sample chamber and contaminate it or move the following samples to bigger distance from the detector where the efficiency of measurement is lower.

The manufacturer recommends that the operator wipes the measuring area once a month with a clear tissue soaked in alcohol.

There are no maintenance requirements for next components of the instrument.

2.2.1. RECOMENDED DAILY PROCEDURES

Users will have to adjust procedures to suit their own requirements. The following are recommended procedures that should be carried out at the start of every shift to ensure system performance is optimized.

- visually inspect the instrument and the measuring area/sample chamber to ensure that it is free of dirt etc. If necessary clean the chamber using alcohol or similar.
- run the gain set up procedure (**Gain setup chapter 3.4.1.**) to ensure the spectrometer is working under the optimal conditions

2.2.2. MONTHLY PROCEDURES

The user should carry out a more complete procedure each month to check overall system performance.

In addition to regular cleaning (**see 2.2.**) it is recommended that the user makes a technical parameters check and total recalibration. You will find a guide in chapter 3.3.

It is strongly recommended that the user keeps a record of the total calibration results and compares the results with those obtained in previous periods to check the overall system performance. Where the user employs non-standard calibration samples with non-standard geometries it is important to repeat all calibrations.

2.2.3. STORAGE AND TRANSPORTATION

The RT-50 instrument must be stored in a dry and corrosion free environment. Storing temperatures are from - 20 to +50 $^{\circ}$C, relative humidity up to 80%.

The instrument is **extremely heavy**. It is **prohibited by the manufacturer to move or transport the instrument en block**. A complete disassembly of the instrument is required. If it is required to move/relocate the instrument users must consult the manufacturer or a service center. Any misuse or unauthorized movement of the equipment could invalidate the warrantee. The manufacturer accepts no liability arising from such actions.

2.2.4. SAFETY

The RT-50 instrument may contain lead. The lead is a dangerous **heavy metal** and it is important to follow all rules and procedures to protect health and environment. Under normal circumstances the lead is covered inside the instrument and there is no unauthorized access to it. Under normal circumstance the instrument is completely safe, however it is important to keep the unit out of any aggressive liquids or gasses which could lead to chemical reactions causing lead containing chemical release.

Any opening of the RT-50 instrument's cabinet must be done with respect to the presence of lead. All manipulation and movement of the instrument must be done under hazardous material safety policy. It is recommended to call service center to provide all works by authorized and specially trained personnel.

End of life disposal of the instrument must be done in accordance with the regulations applying to heavy metals. (**ECO and WEEE – Waste Electrical and Electronic Equipment)**. The shielding **must be removed** from the instrument and deposited as a heavy metal. It is recommended to contact the manufacturer who will provide end of life disposal.

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The RT-50 instrument is very heavy - up to 580 kg (1280 pounds). It is highly important to check the loading limit of the floor of the proposed location for the instrument. The minimum loading limit requirement is for at least 2800 kg/m^2.

Any manipulation with assembled instrument is prohibited!

2.2.5. DATABASE BACKUP

Data backup systems differ from company to company, and are adapted to local conditions. That is why the LabCenter program does not provide its own backup routines, but leaves this up to the user.

The best time for database backup is after setting up the methods and completing calibration. If the database is stored under a new name (e.g. labcenterempty.fdb), it can be used again at any time as a blank database to verify the functionality of the existing database, or as a basis for the new period's database, etc.

The database of the LabCenter program stores information in a space efficient way; it is accessed via an SQL server allowing multiple users to use it simultaneously, however, archiving of databases for a very long period of time may slow down data access. It is always up to the user how many samples are measured over a certain period of time, and what portion of old data needs to be currently accessed. The manufacturer recommends, especially for organizational reasons, to maintain a database for 1 year and back it up afterwards, while creating a new database in the new calendar year. In the case it is requested to view older measurements, it will be easy to find the appropriate database.

Example: The user creates the first database after buying the device in September 2009. The user creates and uses the "labcenter.fdb" database. After the first calibration, the user saves a copy of the database in the "labcenterempty.fdb" file. After the last measurement in 2009, the user will rename the "labcenter.fdb" database to "labcenter2009.fdb" database, and will copy the "labcenterempty.fdb" database to "labcenter.fdb". Then the user will start the LabCenter program as usual and run a new calibration to be on the safe side. If there is not enough time to run a new calibration, the measurements can be done using the old calibration. It is recommended at least to measure the background for the samples (**Calibrate** – chosen method – **Local background**) and / or measure the control sample, for example the calibration standard, making sure that the calibration is still valid.

2.3. SERVICE SUPPORT

2.3.1. REPAIRS

The **RT-50** is a delicate instrument. There are no user serviceable parts inside the equipment. No unauthorized operation inside the instrument is permitted. Such actions could invalidate the warrantee. The manufacturer accepts no liability arising from such actions.

In case of any malfunction - please contact our local service center, dealer or the manufacturer direct.

The Manufacturer's service center is accessible on:

Phone: +420 541 422 231

E-mail: service@georadis.com

3. LabCenter SOFTWARE

3.0.   INSTALLATION

The LabCenter software should start after inserting the USB installation memory stick into the PC USB port. Call **Setup.exe** from the LabCenter/LabCenter directory of the flash memory. Installation menu (Picture 3.0) will display.

Picture 3.0

It is essential to install all three parts during the first installation. Uploading or re-installing any of them in future can be done separately. Part can be installed in any order. Pressing button with written label user triggers installation of chosen part. Installation runs automatically and returns back to the installation menu.

- Install Georadis USB Driver - is execute on the PC with connected RT-50
- Install Firebird SQL Server - is execute on the PC where the data will be stored
- Install Georadis LabCenter - is execute on the PC for spectrometer control

Notes:

In the simplest case it is only one computer, but those works could be divided between more computers.

USB Driver is not necessary in case of DEMO installation.

Supervising of the results can be done only with LabCenter installation.

The RT-50 spectrometer can be connected to the PC after successful installation of USB Driver. It starts **New Hardware Guide**. Refuse the connection to the Windows Update on the first screen via **Not now** selection and confirm all other suggestions.

3.1   FIRST RUNNING - CONNECTION TO THE DATABASE

The user must arrange an access to the SQL server that support storage of the settings and results. It can be used with any customer's SQL using customer defined access to their own network, or can be run on a local SQL server on the local PC.

It is arranged automatically during the first startup of the LabCenter or it can be run any time via program **Database setup** (shortcut **Database setup** located on **Georadis** - **LabCenter** folder in **Startup** menu).

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The selection of the database language appears first followed by the screen like Picture 3.1.

Picture 3.1

After the selection of the computer where the database is located the password must be entered. The initial password is „**masterkey**". The password can be modified later according to the chapter 3.3.2. Click on the **Connect** button activates the bottom part of the window.

As the button descriptions leads new database can be created, the existing one opened or the selected one can be deleted. Usually is used **labcenter.fdb** in **Documents\LabCenter** folder of the actual user. Than the automatic templates could be used for the usual types of measurement - compare Picture 3.2.

Picture 3.2

Those are:

- Measurement of Co-60 in steel samples,
- Measurement of Am-241, Co-60, Cs-137, K-40, Ra-226 and Th-232 in dust samples or
- Measurement of Cs-137, K-40, U-nat. and Th-nat. in geological samples.
  The user select **Yes** at the type he want to use. It is possible to select all of them, some of them or no one.

The created template methods are exemplary ones. There are proper radionuclides with suitable Region Of Interest (ROI) for their evaluation but it is necessary to modify the names of the etalons, their reference dates and activities according to the Protocols and etalons supplied with the RT-50 spectrometer.

The user can define any number of the fields for sample description. The only commonly used fields that are important for running of the SW or for evaluation of results are preset. The details are in the chapter 3.3.4.

Not using the preset templates the new empty database is created. It is necessary to fill in all parameters and values for the method. This is recommended only for advanced user.

Click on the **Open database** button opens the dialogue **Open database**. The selection of the folder and database confirmed by **Open** button causes the database connection. It's name and path is displayed under the buttons for database manipulation.

When the installation is provided by Administrator and the user have no access to the **Administrator's Documents** folder, where the database can be located, it is necessary to type the correct path and database name to the Open database window manually using keyboard without dialogue **Select** use. The same way must be used for connection to the database on the computer connected by the PC net.

Delete database proceeds according to the Windows practice. Database for deleting must be opened first, after deleting the new one should be opened.

Creating or opening the database must be confirmed by clicking on the **OK** button. The active window is closed. Next run of the LabCenter proceeds according to the followed chapters.

## 3.2. GRAPHICAL USER INTERFACE - MAIN PANEL

The LabCenter is activated by clicking on the shortcut from the desktop. The program is password protected. When the popup window Database login (picture 3.3.) appears the correct user name and password must be entered to access the main panel.

Picture 3.3

The GUI main panel (picture 3.4.) has access features. From the top down the following appears.
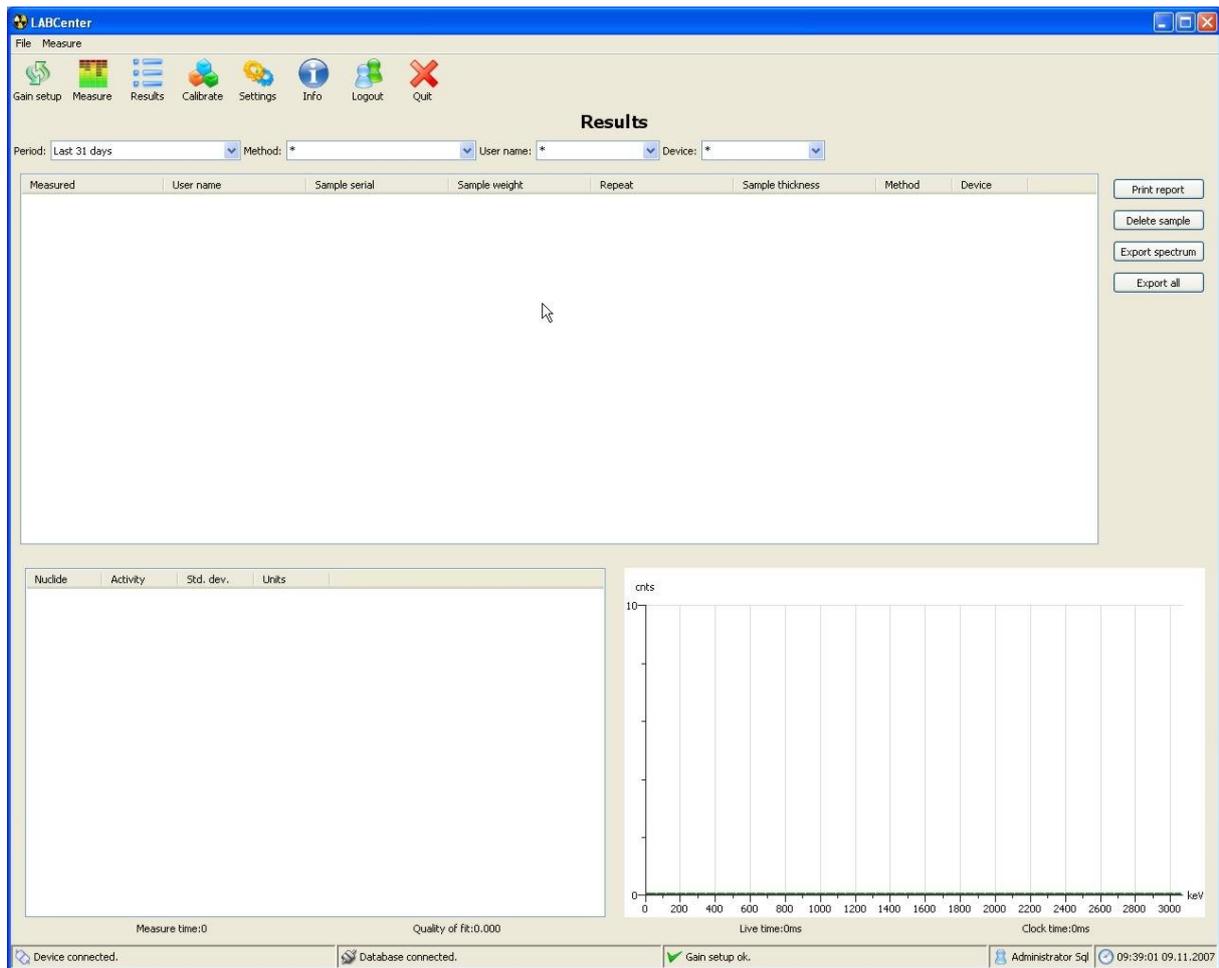
Picture 3.4

- Main bar with program's name.
- Main menu bar with text items **File** and **Measure.**
- Below the main menu bar is a bar with icons - speed buttons.
- Compo boxes below icons serves to filtering of displayed results. User can select criteria for faster orientation in the results database. Sorting keys are Day Period, Method of Measurement, User Name and Device.
- At the very bottom of the page is a status bar with five message fields.

The first field is reserved for MCA status. There are three messages alternating. **Device connected**, **Deviceless mode** for any demo or reanalysis from database and **Device not connected!**

A correct login in to database indicates a message **Database connected** (second field from the left). Message **Database disconnected** announces any problem with the database.

The third field indicates readiness to measure. Message **Gain setup** alternates with error message **Gain setup timeout!** where a gain has to be adjusted prior to a measurement. The timeout is preset for 8 hours which means that the system requires a gain setup every 8 hours. Setting the gain every 8 hours minimizes any influence of the ambient temperature on results.

A user name, actual date and time is displayed in the last field of the bar.

Main menu. Clicking on **File** activates the following drop down menu:

- **Logout** user's logout,
- **Settings** program setup
- **Quit** for quitting.
  Clicking on **Measure** activates:

- **Gain setup** – MCA gain adjustment
- **Measure sample** – measuring of a sample
- **Results** – browsing of the results database
- **Calibrate** – calibration procedures.

3.3.   FIRST START – CONFIGURATION

A default setup is done during the installation process. Most users use the default setup settings.

For customers who want to customize their program the following procedure should be performed.

Activating of item **Settings** from menu or speed button **Settings** will generate eight tab cards each with a variety of user selectable parameters.

3.3.1. MEASURING DEVICES

Gamma measuring device

Device type: RT-50

10001024

Device:10001024

Apply

Scales

Scales COM port: COM2

No scales
Axis A500R
Chyo YMC LABO MK-500C
Mettler Toledo AB-S/PB-S
Ohaus Adventurer
Radwag WAA/WAS/WPS
Radwag PS

Scales:Radwag PS

Apply

Picture 3.5

The tab **Measuring devices** (picture 3. 5.) harbors two windows with a list of selectable items, **Gamma measuring device** and **Scales**. The LabCenter supports different types of MCU (Measuring devices) and balances from different manufacturers. The relevant MCU or Scales can be selected by highlighting the relevant item from the list. Clicking **Apply** will trigger communication with the selected device. The serial number of the chosen instrument is displayed if the initialization is successful.

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The manufacturer supports two types of MCA - **RT-50 Georadis** and **GR 320 SAIC - Exploranium**. On the list of scales there are **Axis A500**, **Chyo YMC LABO MK-500C**, **Mettler Toledo AB-S** or **PB-S**, **Ohaus Advanturer**, **Radwag WAA/WAS/WPS** and **Radwag PS**. LabCenter expect the communication with any scales via serial line. User can find default set up for most common scales in the next table.

Scales Type	Axis A500R	Chyo YMC LABO MK-500C	Mettler Toledo AB-S/PB-S	OHAUS Advanturer	Radwag WAA/WAS / WPS	Radwag PS
Baud Rate	4800	2400	2400	2400	4800	4800
Data Bits	8	8	8	8	8	8
Parity	No	No	No	No	No	No
Stop Bit	1	1	1	1	1	1
Flow Control	No	No	No	No	No	No
Character for Weight Sending	SI	D	S	P	SI	S

If other scales are to be used then a separate driver for that scale can be added to the LabCenter. The customer shall submit a data and command format to the manufacturer in order that the plug-in can be integrated with the program.

3.3.2. USER'S LIST

Picture 3.6

Tab **Users** - Picture 3.6 - lists defined users and their access rights. **Login name, First name, Last name** and **Clearance** are stored with every result or calibration. The Clearance limits access rights by categories. There are:

- **Administrator** – full access to all files and features. It is restricted for manufacturer's personnel.
- **Power user** – partially limited access for calibration, measurement and parameter setup. It is rated for managers.
- **User** – limited access for worker. Only measurement and gain setup are accessible.

Adding a new user or modification of a current user can be done using buttons located on the right side of the list. Touching any of the buttons leads to an editable popup screen. The user can change any of the items. New values are stored after touching buttons **Add user** or **Modify user.** To exit screen without any change use the **Cancel** button.

Delete user opens a confirmation window to double check operation before permanent data erasing.

3.3.3. NUCLIDE LIST

Only suitably qualified personnel should edit the following tabs.

Nuclide list

Name	Half life	Unit
Am-241	432,20	Years
Ce-139	137,66	Days
Co-60	5,27	Years
Cs-134	2,06	Years
Cs-137	30,17	Years
I-131	8,04	Days
K-40	1277,00	Million years
Kr-85	10,72	Years
Ra-226	1600,00	Years
Th-232	14000,00	Million years
U-238	4468,00	Million years
Uran 235	703,80	Million years

New nuclide
Edit nuclide
Delete nuclide

ROIs

From	To	Color
520,0	670,0	Red
720,0	870,0	Red
1300,0	1530,0	Red

Add ROI
Edit ROI
Remove ROI

Picture 3.7

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Tab **Nuclide list** - picture. 3.7 - is a list of nuclides with their half-life and ROIs (region of interest) which can be assigned to any spectral evaluation method. User can edit current, add new or delete nuclides from the list. The editing is fully interactive and the user must fill all relevant data on the editable sheets. It is obvious that unskilled change of any number can lead to fatal errors during evaluation.

Buttons **New nuclide, Edit nuclide and Delete nuclide** activate related edit sheets. Editing of **ROIs** follows the same principals. The pop-up window with the list of nuclides from the library for nuclides identification appears during adding new nuclide to choose the same description for nuclide used in calibration and identification mode of evaluation.

The half-life and the corresponding units should be derived from a reliable source, as the current activities of the standards are recalculated according to it, which substantially affects the calculation of activities of the sample.

Likewise, the regions of interest (ROI) should be chosen wisely. If wide regions, or low efficiency peaks, are chosen, then the uncertainty of the measurement increases as a result of calculations with low numerical values, which may even lead to erroneous results. On the other hand, too narrow regions provide little information for the simulation of the measured spectrum, which again increases the uncertainty of the measurement. The ideal border of the peak is at approximately 5 percent of the maximum relative height. When a new peak is entered, it is necessary to define the lower (**From :**) and upper borders (**To :**) of the peak and **Color** for the highlighting in the view of spectra. Any number of ROIs may be set for each nuclide.

3.3.4. SAMPLE DESCRIPTION

Tab **Sample description** - Picture. 3.8 - allows to user to define its own database structure as every user has different requirements on sample identifiers. Sample description tool helps to integrate LabCenter data output to existing company data structures. Each sample description item has its unique **Name**, simple **Description**, **Type**, **Minimum** and **Maximum** values and **Allow empty** and **Remember last** attributes.

Sample description

Name	Description	Type	Minimum	Maximum	Allow empty	Remember last
SAMPLE	Sample serial	String			No	Yes
WEIGHT	Sample weight	Weight			No	Yes
REPEAT	Repeat	Integer number	1	20	Yes	Yes
THICKNESS	Sample thickness	Real number	4.00	60.00	No	Yes

New field
Edit field
Delete field

Picture 3.8

The **Name** is a unique name that will be assigned in the database. It is highly important to follow user's internal company's own procedures for creating data structures to guarantee a future compatibility inside the company's database. The **Description** is used to better specify the content. Type of the item defines its format. The following types are predefined:

- **Integer** number
- **Real number** a float number with decimal point
- **String** a chain of characters
- **Weight** this allows communication with scale

    After choosing a type the user will continue with button **Next >>.**

Entering **Minimum** and **Maximum** and **Allow empty** set up an internal policy and can protect user against typing errors. For String types it is recommended to enter maximum length in characters.

For **text** fields, you can specify items for a **pull-down menu** if several items are repeated. The **Define string** button appears next to the **Field description**. After it's activation, it is possible to insert individual items into the menu - **Add**. The entered value can be corrected or deleted. The **Cancel** button exits the window without saving, the **Save** button saves the current menu. When entering a field description prior measuring a sample, click the arrow at the end of the field to expand the pull-down menu and select the appropriate item.

The field **Remember last** allows displaying the last typed value in the appropriate field when window for new sample appears on the screen.

Edit field allows a change of description. Change of the **Name** and string **length** is restricted. Typing button **Modify field** will update the database. Button **Cancel** abandons the edit screens. Selected existing items can be erased from the visible part of database by using Delete **field**. Note that the space for once saved field will be reserved in the database in spite of it will be invisible. So the deleting of a field does not reduce the volume of the database.
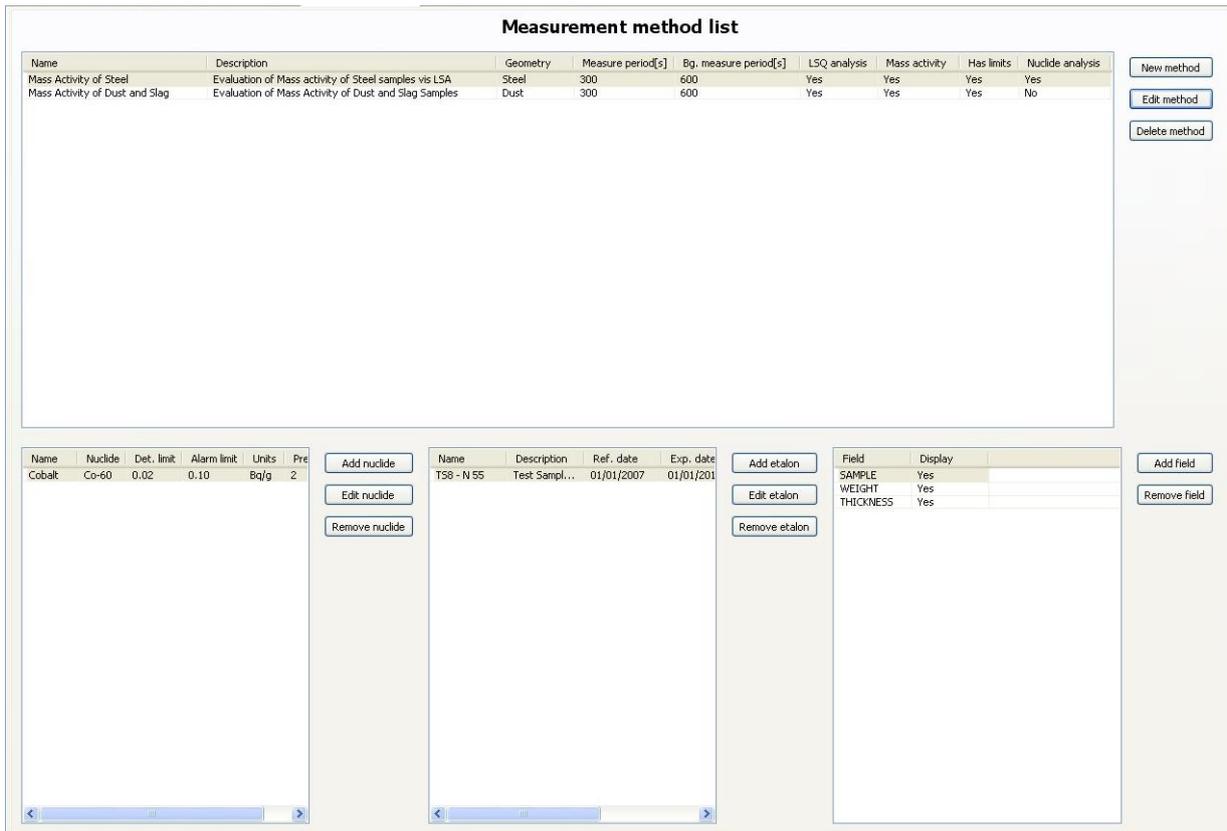
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3.3.5. MEASUREMENT METHODS

.**Fig. 3.9**

3.3.5.1. Method parameters setting

The whole analysis procedure can be set up in the **Measurement methods** tab – Fig. 3.9. There are various methods implemented in the program, which are merged to form the final analysis. Users can select appropriate methods according to their requirements. The **Measurement method list** upper pane shows a list of all available measurement methods including their basic description; the three panes below allow for the selection of the analyzed radionuclides, applicable standards and sample descriptors pertaining to the method highlighted in the upper pane.

The user can add a new method (**New method**), edit an existing one (**Edit method**), or delete any of the methods (**Delete method**). A new method can be added by clicking the corresponding button.

First, it is necessary to fill in the **Name** of the method in the newly opened **Add a new method** window, and its **Description**. The description is used for ease of reference. A measurement **Geometry** must be defined as well as sample (and etalon) measurement times, **Measure period[s],** and background measurement times, **Bg. measure period[s]** (all in seconds).

Measurement geometry options:

- **Steel** - ferrous metal roller with a diameter of 35 mm and height of 10 mm. The expected tolerances are: specific mass of 7 - 8, flat base larger than a circle with a radius of 20 mm and smaller than a circle with a radius of 50 mm, material thickness of 4 - 50 mm and total weight of 20 – 800 g.

This geometry is also used for measurement of other metals as Aluminium, Copper, Zinc … but the parameters of the sample must be modified to suit different metals and sample dimensions.

Fig. 3.10

- **Dust** - loose material in a container of 100 cm^3 and apparent density of 1.2. The expected tolerances are: specific mass of 0.8 – 1.6, full container, with a particle size less than 5 mm in diameter.

  This geometry is also used for measurement of Building materials and similar dusty materials with modification of mentioned parameters.

- **Rock** – loose material in a container of 100 or 300 cm^3 and apparent density of approximately 1.6. The expected tolerances are: specific mass of 1.0 – 2.0, full container, with a particle size less than 5 mm in diameter.

- **Water** – aqueous solutions in a container of 300 cm^3 and density of 1.0. The expected tolerances are: specific mass of 0.8 – 1.2, full container, no heterogeneous sediments.

  The **sample measurement time** depends on the desired accuracy of the measurement. A minimum of **300 seconds** is recommended for routine measurements. 60 to 120 seconds are sufficient to obtain indicative values; 600 to 1800 seconds are recommended for precise geological measurements.

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The **background measurement time** should be at least 300 seconds; it should be 2 times longer than the sample measurement time for steel samples and indicative measurements. If the sample measurement time is 600 seconds or longer, the background measurement time can be the same as the sample measurement time.

Other parameters are selected based on the **Least square analysis** (LSQ) method for the simulation of the measured spectrum, assessment of **Mass activity,** total activity, and monitoring of limit exceeding (**Has limit**).

LSQ simulates the measured spectrum based on the calibration standards spectra; it is therefore necessary to perform calibration before starting the measurements, and measure the standards spectra and the background spectrum. The final results achieved by this method have the maximum possible accuracy. Standard deviation obtained from measurement statistics is added to each result. The result is marked with the letter **C** (**C**alibration) at the beginning of the line with the results.

Another method for spectral evaluation is the **Nuclide analysis:** (NA). This method searches peaks in the spectrum and their position compares with a library of radionuclides. In case of equality indicates the presence of radionuclide. Estimation of its activities is calculated from the peak areas. This method does not require any calibration, but the accuracy of the results is significantly worse than in the case of least squares. Therefore no deviations or measurement errors are calculated. If a peak is detected that does not belong to any of the radionuclides in the library, instead of the name of the radionuclide it is labeled as **Unidentified**. Its activity is set at zero, because the program cannot know the efficiency of the measurement. The result is identified with the letter **I** (**I**dentification) at the beginning of the line with the results.

The user can select either the default library of radionuclides (the default library) or user one. The default library contains common radionuclides. If there is an assumption of finding other radionuclides, it is necessary to assign a user library to program LabCenter using the **Assigned user library** button. If the user needs to create a new library, he should contact the manufacturer of RT-50 with a request for its creation with a list of required radionuclides. Sending spectra of these radionuclides measured by spectrometer RT-50 greatly facilitates the creation of libraries.

If both evaluation methods (LSQ and NA) are selected and both evaluate the same radionuclide, the result calculated by the least squares method is displayed. Line with the results started by two letters: **CI**. Names of nuclides must be exactly the same otherwise the results will appear in two rows, one for each method.

If **Mass activity** is set to **Yes,** the mass activity is evaluated using the LSQ method. The weight of sample must be load from scales or be typed manually for this selection. Otherwise the total sample activity is calculated.

Setting the **Has limit** parameter to **Yes** will result in a comparison of the measured values with the admissible limits. Subsequently a message is generated in the result window: **SAMPLE OK** or **SAMPLE ABOVE LIMIT X**. The three levels of alarm can be set for each nuclide and/or for combination of them. If the user wants to have different messages he can use the user setting in the window **Reports** – **Assign user messages**. Compare chapter **3.3.8.**

The following 12 parameters are used to set the limits for combinations of activities. Sometimes it is not enough to monitor the compliance with the limit for each of the tested radionuclides, especially when it is a mixture of several radionuclides.

One option is checking of activities sum - **Check summ. activity:** LabCenter counts the sum of activities of the selected and found radionuclides, and compares it with the limit specified in the following item, **Summ. activity limit Lev. X:**. This method is used for testing the "total cesium activity", i.e. the sum of the activities of Cs-137 and Cs-134 radionuclides in foodstuff in areas affected by the Fukushima accident.

The Summary activity can be compared up to 3 levels set in the next three fields **Sum. activity limit Lev. 1:** - **Sum. activity limit Lev. 3**. The exceeding of each level is indicated by the messages set in the window **Reports – Assign user messages**. Compare chapter **3.3.8.**

The other two options are the sum of standardized activities - **Check norm. summ. activity X:**. In those cases, the measured activities of each radionuclide are divided by their value called **Normalized summary index**, and these quotients are added up for all nuclides marked for such combination limit in the list of nuclides – compare **Add to summary** fields on the Fig. 3.11. The resulting value is compared against limits typed in the following three fields **Norm. summ. activity X limit Lev. Y:**. Those methods are, for example, used for the identification of the category of sources (insignificant, small, simple) for mixtures of different radionuclides or for evaluation of Building materials – calculation of Internal or External Irradiation Indexes.

Clicking the **Add Method** button will store the set values in a table; the **Cancel** button will terminate the data entry process without storing.

Use **Edit method** for additional adjustments to an existing method; **Delete method** will remove the method so that is it not visible for the user, but is kept in the database. The size of the used database will thus not change.

3.3.5.2. Nuclides parameters setting

There are three more windows under the method list. Use these windows to enter predefined radionuclides, calibration samples used and field database structures for sample description for each method used. Their proper combination will create a wide variety of methods.

A new radionuclide can be added to the table by clicking the **Add nuclide** button and after filling in the newly opened window **Add a new nuclide**, see Fig. 3.11. Radionuclides are selected from the **Nuclide:** list, in which radionuclides specified in the **Nuclide list** will be shown that have not yet been chosen for the method. This ensures that one radionuclide cannot be entered twice. For each radionuclide, the following should be filled in:

- **Name:** - name or specification of the radionuclide that will be displayed in the results table

- **Detection limit:** - the smallest detectable concentration or activity (distinguishable from zero)

- **Alarm limit Lev. 1:** - the **SAMPLE ABOVE LIMIT 1** message is generated if the activity limit is exceeded. The user can define another message set in the window **Reports – Assign user messages**. Compare chapter **3.3.8.**

- **Alarm limit Lev. 2:** or **3:** - when the measured activity exceed one of this value the user can define a message (in the window **Reports – Assign user messages**) that appears in the result window. Compare chapter **3.3.8.**

- **Units:** - units in which the analysis is being carried out

- **Precision:** - number of decimal places in which the results are displayed

Fig. 3.11

- **Suppress from results:** - option to exclude a particular radionuclide from the list of analyzed radionuclides. This situation occurs very rarely. For example when analyzing particulate material in metallurgical plants, a non-zero activity of potassium is detected. Potassium is found in natural form only, and thus any activity of potassium does not limit the application of the tested material in any manner, so it is not necessary to display this activity. On the other hand, potassium must be included in the LSQ analysis, because otherwise there would be no successful simulation of the measured spectrum and the **Unidentified** nuclide message would be generated, causing the **SAMPLE ABOVE LIMIT** message to appear.

- **Add to summary:** - option to include the measured activity into the calculation of combined limits (see this chapter above)

Clicking the **Add nuclide** button will save a new nuclide in the table; the **Cancel** button will terminate the entry procedure for a new radionuclide.

The **Edit nuclide** button can be used for correction of selected radionuclide parameter settings. **Remove nuclide** will remove the radionuclide from the method.

3.3.5.3. Etalons parameters setting

A new standard (calibration sample) is added into the table by clicking the **Add etalon** button and filling in the values in a newly opened window **Add a new etalon**.

The following details that are listed in the Protocol about the Measurement of Calibration Samples or in Standard Document, should be entered for the standards:

- **Name:** - name of the standard. It should agree with the name printed directly on the calibration sample
- **Description:** - detailed description of the standard
- **Reference date:** - date as of which the activity of the standard is certified
- **Expire date:** - date by which it is possible to use the calibration sample (usually 15 years or 3 half-lives since the reference date, whichever is smaller)
- **Weight:** - weight of the standard
- **Radionuclides** - activities of the analyzed radionuclides in the standard. Units listed in the nuclide table on the left are to be used.

The data fields can be filled in using the calendar that opens after clicking the pull down arrow at the end of the field, or overwriting the time data shown (day, month and / or year). The user can scroll through the calendar month by month using the left or right arrows. The year can be selected after clicking on a current month; scroll through decades is able after clicking on the current year, etc. By clicking on the selected year, the months will be shown for next selection. The selected date is to be confirmed by clicking on the particular day or by pressing the ENTER key.

By clicking the **Add etalon** button, a new sample will be added to and stored in the table; the **Cancel** button will cancel the procedure of entering a new standard.

The **Edit etalon** button can be used to make corrections; **Remove etalon** will remove the standard from the specific method.

Activities in this table (they will be displayed after moving the horizontal bar to the right) are shown as a fraction: 4.34/3.95, where the first number is the activity of the radionuclide in the sample as of the reference date according to the Protocol, and the second number is the current activity as of the current date and time.

3.3.5.4. Selection of fields for method

The **Add field** button will save a new field for the description of the sample into the table. A new field is selected from the field list, which includes fields entered in the **Sample description** tab that have not yet been selected for the applicable method. This ensures that one field cannot be used twice. If all available fields are selected, the **No field** window will appear instead of the list reading **No field available!**, which must be confirmed by clicking the **OK** button.

In the same order as the user selects the fields, the fields are displayed both in the list and when the description of the sample during the measurement is entered. It is therefore advisable to choose the fields in a logical order when entering information about the sample. If it is necessary to change the order of the fields, this can be done by removing the field located at the top and adding it back at the end of the selection.

The **Remove field** button will remove the selected field from the list.

3.3.6. CORRECTIONS

Tab **Corrections** - Picture 3.12 - allows including the correction of the activity evaluation according to one of parameters. The basic use of this is the correction for the sample thickness in case of mass activity of Co-60 in STEEL samples due to it may vary between 5 and 20 mm. The table of correction function must be saved on the hard disk in text form to be downloadable to the database. The details about it's structure are in the chapter 4.4.

To assign the correction table to appropriate measuring method a row from the list on the tab with requested method must be selected first. Then become accessible button for assigning describe the field for correction, choose the sample parameter used for correction and select the file with the appropriate table (usually in the subfolder CORR). After confirmation by **Add correction** button the table is load to database and ready to use in evaluation process.

Being assigned the table can be edited, saved or removed as it is seen on the buttons in the Corrections window.

Using this possibility is recommended only for advanced users due to it has the essential influence to the analysis results. In any doubt contact the producer technicians.

Picture 3.12

3.3.7. OTHER PARAMETERS

Tab **Other parameters** - Picture 3.13 - allows selection of the following:
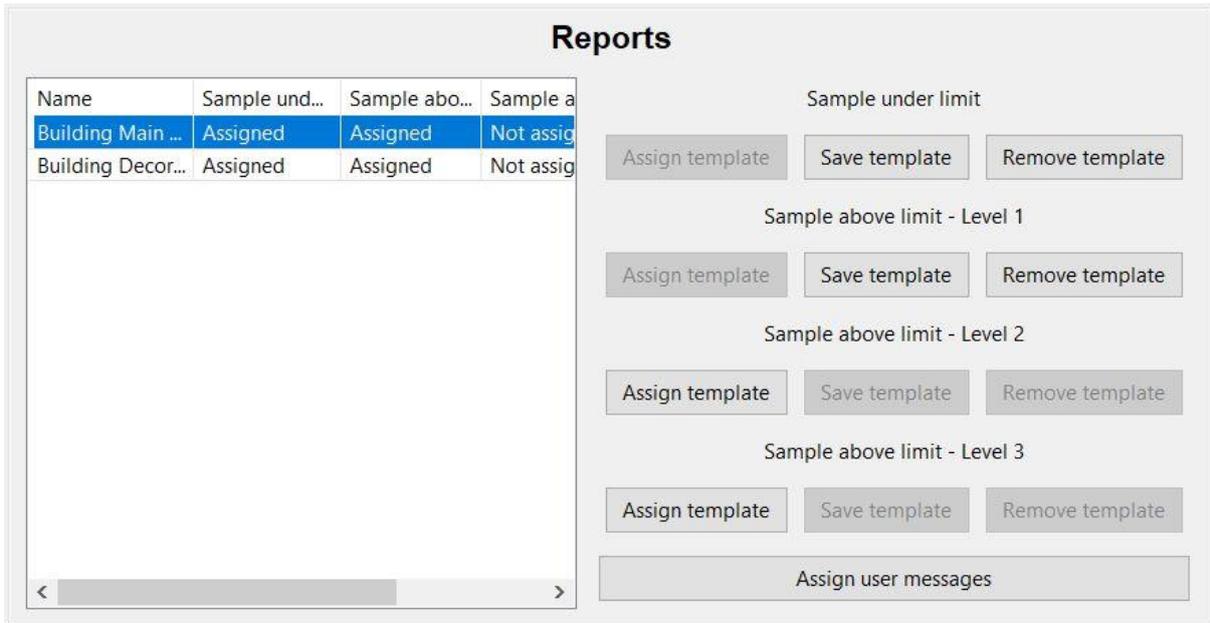
Picture 3.13

- **Stabilization nuclide:** instructs the MCA which peak pattern will be used for setting of the gain. Currently **Cs-137** data in two modes and **Co-60** are available. **Gain only** is used for quick stabilization during normal operation; **Gain & Offset** is used in case of doubts about the correct energy calibration - positions of peaks. The second method takes longer time - see the paragraph below. Producer suggestion is to set the Stabilization period to 300 seconds instead of 120 seconds in case of **Gain only** setting.

- **Stabilization period[s]:** Defines the time of spectra acquisition prior to stabilization error is displayed. So it is maximal time of stabilization. When exceeded, the error message appears: **Gain setup error! Insert source and try again.** The suggested period for stabilization is 120 seconds. The used photo-peak(s) should reach 100 counts in maximal counts channel. The right positions of peaks are labeled by red vertical lines in the spectrum.

- **Stabilization expire[hr]:** After this time in hours the message **Gain setup ok.** in the bottom bar changes to message **Gain setup timeout!** to inform the user that the gain setup procedure is useful to provide.

- **Export file:** When user define the path and file name in this field the text file is created (if not exists) or is appended by the actual result after the measurement is finished. The first line is a header of fields and following lines are the values separated by semicolon. The CSV suffix is recommended.

- **Language:** of the user interface. Change of the language is valid after restart of the LabCenter program. For possibility of translation the LabCenter SW to different language see chapter 5.1.5. or contact the producer.

- **Print after measure:** Allows starting of the protocol print out dialogue immediately after the sample measurement is finished. The template of the protocol is set in the window **Reports** – see chapter **3.3.8.**

3.3.8. REPORTS

Picture 3.14

Tab **Reports** – see Picture 3.14 - allows choosing output forms for printouts. Forms are written in **html** format and customer can arbitrarily modify them in any html or no-formatting text editor, for instance Notepad. User can assign forms for used sample types. For indication of results below and above alarm limit levels (1, 2, 3) can be used different forms. To assign a form to appropriate measuring method a row from the list on the tab with requested method must be selected first. Then become accessible buttons for **Assign**ing of the template if no one is assigned, or **Sav**ing and **Remov**ing of the assigned templates. The predefined forms are saved in the subfolder **local/**_language_**/reports/**_geometry_**/** of the **C:\Program Files\LabCenter** folder. When no limit is checked the form "**Sample below limit**" is suitable.

The **Assign user messages** button allows the modification of the standard messages: **SAMPLE OK** or **SAMPLE ABOVE LIMIT** on the screen of results during the measurement and set next two messages for the next two cases of limits exceeding. Those limits can be set in the **Measurement method list** – **Sum. activity limit Lev. 2:** or **Alarm limit Lev 2:**. Compare chapter **3.3.5.**
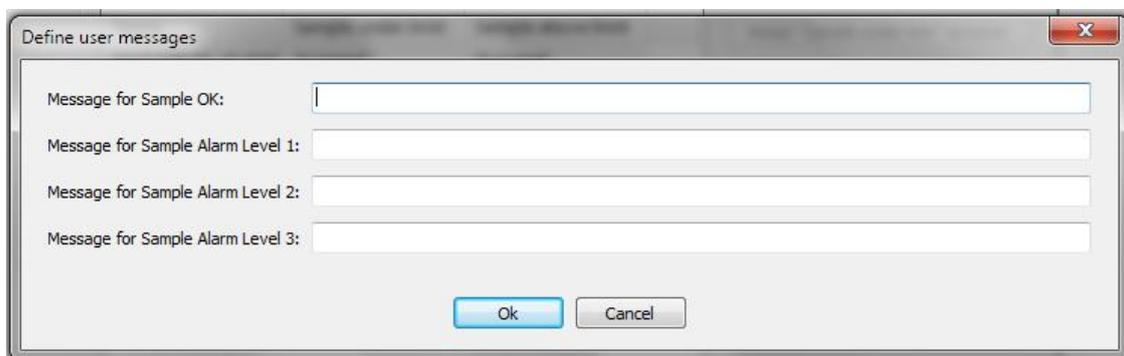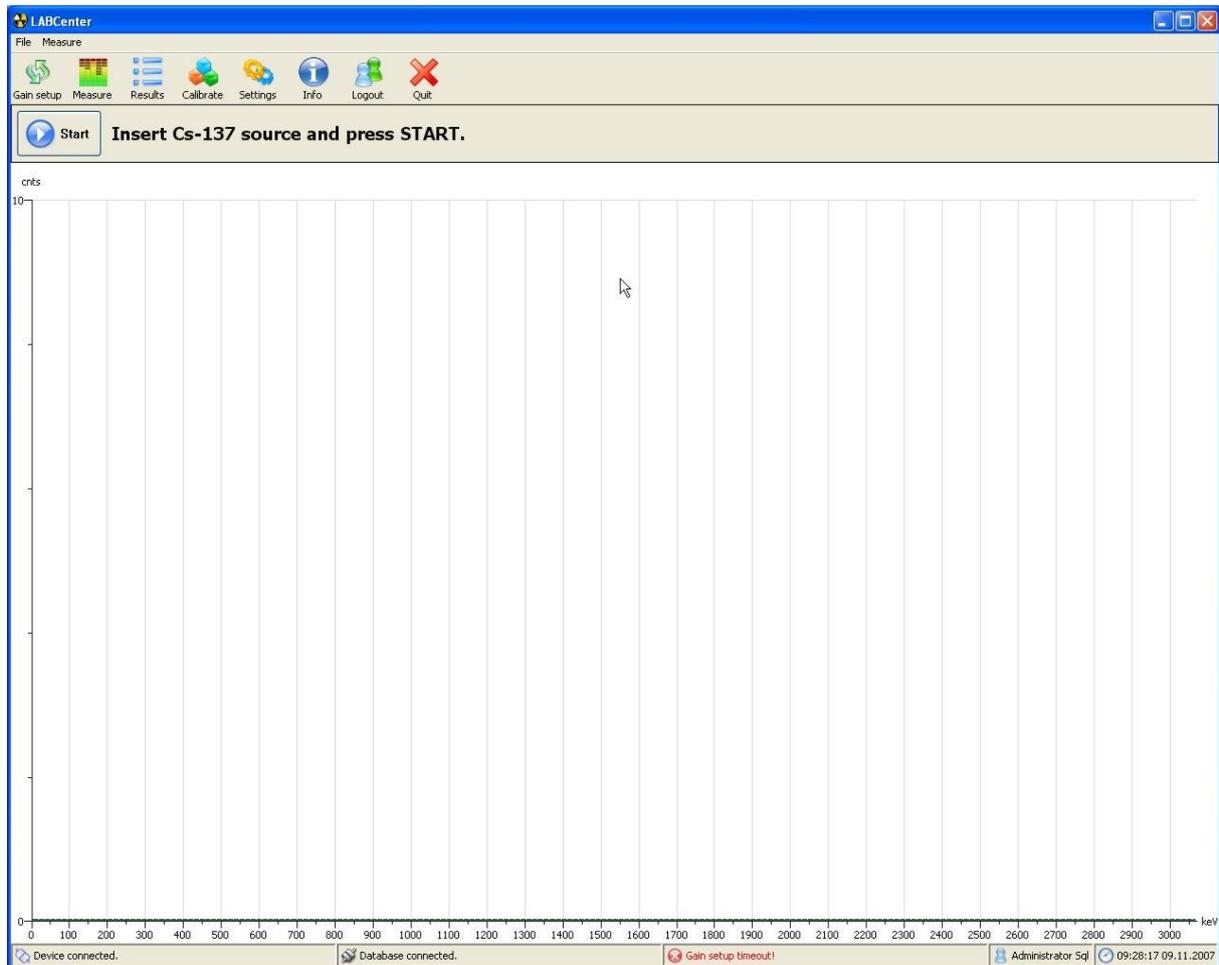

Picture 3.15

3.4. CALIBRATION

A calibration is a process that foreruns a sequence of measurements. Calibration consists of measuring of samples with a known activity (calibration standards) and the response of the local background. It is important to perform calibration with a well-tempered and adjusted system, because bad calibration will influence the future chain of measurements. It is important to start the calibration process with **Gain setup**, to compensate all gain shifts caused by temperature.

3.4.1. GAIN SETUP

Type **Gain setup** from menu item **Measure** or use speed-button **Gain setup**. A new button **Start** - see picture 3.16 - appears on desktop. The button is accompanied with text label **Insert Cs-137 source and press START**.

Picture 3.16

The remaining desktop area is covered with a graphics chart. Insert Cs-137 source in the sample chamber in the RT-50 and close the lid. Push button **Start** - icon and label of the button will flip to **Stop** – see picture. 3.17. Also the label on the right changes to **Gain setup progress:** A new spectrum of the test source is being collected. Progress of the stabilization is displayed on the bar on the top of the chart.

On the chart there is displayed an animated spectrum of the test source. Expected positions of peaks are marked with red vertical lines. Once triggered, a new ADC gain and offset is computed and applied. System checks allowed deviations and in case of positive test result the message **Gain setup successfully completed.** will

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be shown. A negative test leads to repeating of the stabilization procedure. Five attempts at successful stabilization are permitted. Unsuccessful gain setup means a fatal problem and the process of calibration or any measurement cannot continue.

Notes:

The successful gain setup is confirmed on the bottom bar by the message Gain setup ok. The new gain setup is asked after 24 hours (or time set in Other parameters menu) by the message Gain setup timeout!.
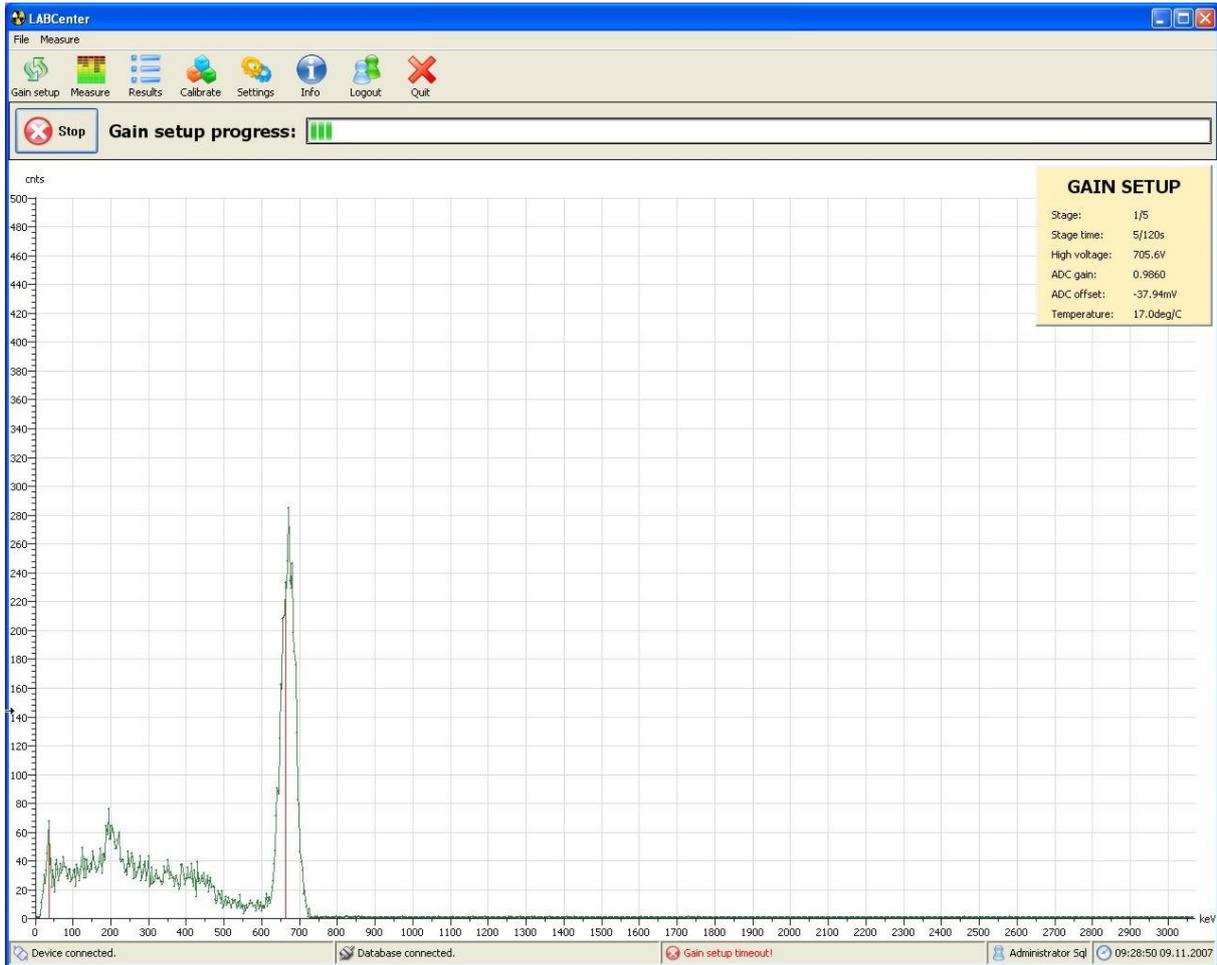
Picture 3.17

3.4.2. CALIBRATION

A **Power user** or **Administrator** is required to perform calibration.

Calibration starts after selecting **Calibrate** from the **Measure** menu or via speed-button **Calibrate**. An interactive list of available measuring methods appears on desktop (picture 3.18.) with **Select measurement method for calibration** in the header. The required method to be calibrated is selected via the related button. The next screen will show **Select etalon for calibration** – picture. 3.19.
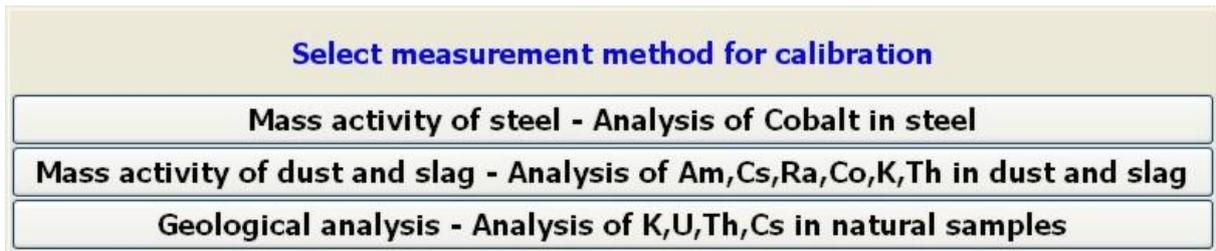
Picture 3.18
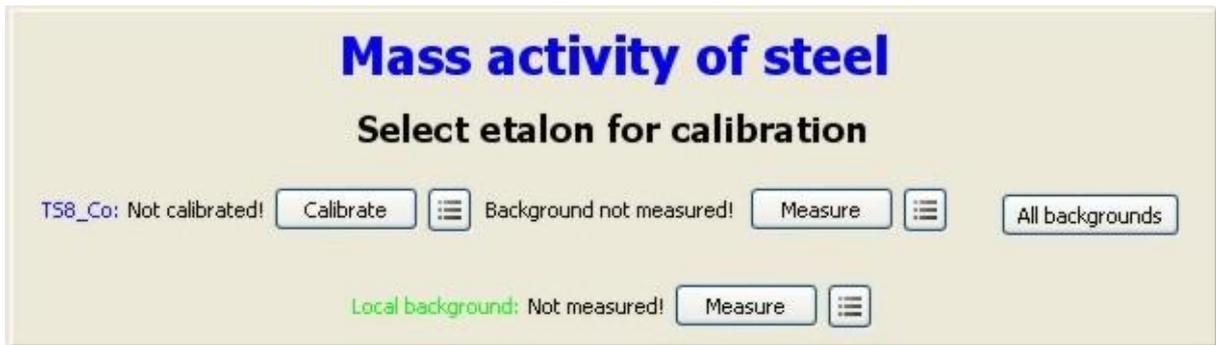
Picture 3.19

LabCenter software allows measurement of each standard independently. The user must ensure that all expected standards plus background will be measured. Besides the standard's name, information about the last performed calibration is also displayed. The label **Calibrated:07/16/06 11:41:39** displays the last calibration date and time or message **Not calibrated!** alerts that the standard has not been measured at all. Assigned button **Calibrate** starts the measurement. The LabCenter software allows one single background measurement to be assigned to all standards - button **All Background -** or to measure partial background immediately after measurement of the appropriate etalon.

Where a complete calibration of all required standards in one batch is undertaken it is not necessary to measure partial backgrounds for each etalon. However this must be done if only selected standards are measured. Each etalon measurement should be accompanied with actual background to allow for daily background variations.

The last item is **Local background**. The local background is subtracted from any sample spectra in almost all computation methods. It is recommended to measure impact of local background more often than the system is calibrated. This is to minimize the background fluctuation on results. As a time saving feature, the implemented calibration procedure allows correction of partial standards without the requirement to repeat the whole calibration procedure.

Performing calibration means measurement of the spectra of all calibration samples and background. The order of execution of these operations is fully let on the user, which means that he has to start measurement of each calibration sample separately and also background measurements. On the other hand, this has the advantage that the calibration can be interrupted at any time and in the meantime the urgent sample can be measured by another method. Another advantage is that in case of a measurement error in any of the spectra (unclosed sample chamber cover, incorrect sample insertion, sudden background change due to the presence of a strong external emitter,…) only one incorrect measurement (with background) is required to correct calibration – not necessary to repeat the entire time-consuming calibration.

After selecting the button **Calibrate** or **Measure** a spectral chart will display on desktop - Picture 3.20 - with button **Stop** on top and label **Calibration progress:** or **Background measurement progress:** with progress bar on the right. The **x** axis displays energies in the spectrum in **keV**. The **y** axis counts the number of registered pulses in **cnts**). Pre-selected ROIs (regions of interest) are highlighted green in the spectral chart. This allows the skilled user rapid orientation and supervision of the calibration process.
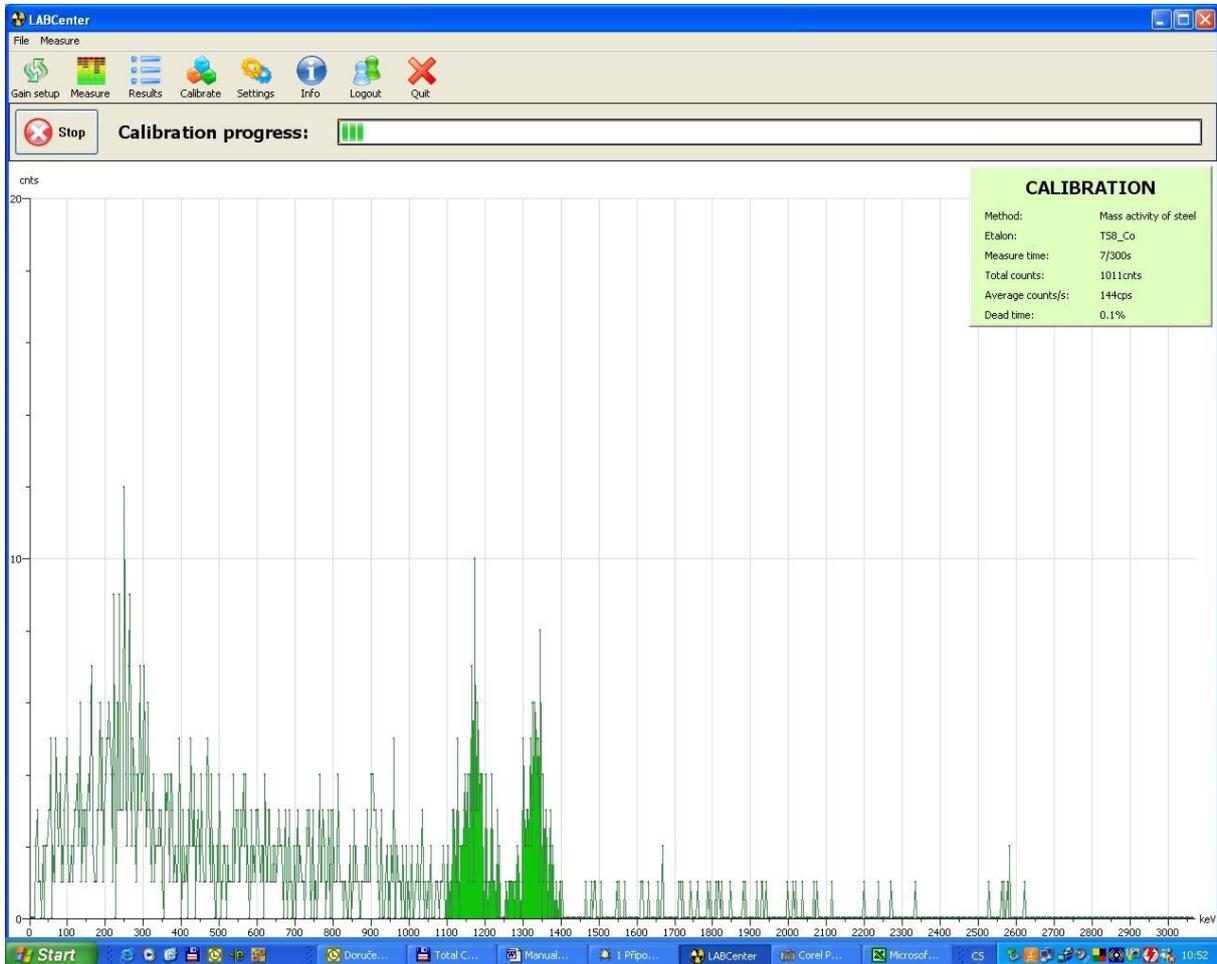
Picture 3.20

Spectrum acquisition may be interrupted via the **Stop** button. A message box - **Calibration abort** - picture 3.21. - with the question **Do you really want to abort calibration?** offers a last chance before abandonment of the standard measurement. Typing **Yes** aborts measurement and the spectrum is lost. **No** reverts the system back to the measuring loop.
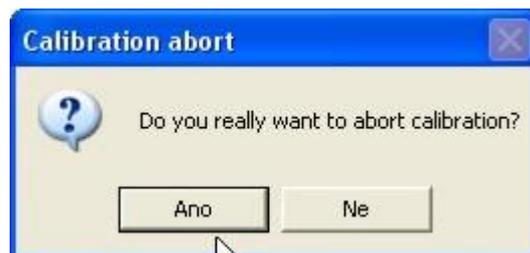
Picture 3.21

A success of a standard measurement run will be finished with header **Calibration setup** - picture 3.22 - and message **Background measurement** (**Calibration**) **successfully completed.** Confirm by selecting **OK.**

Picture 3.22

When all standards and background measurements are completed the calibration is finished and a sample measurement can begin.

It is recommended to provide the backup of the database according to the chapter 2.2.5. after the first calibration.

3.5. MEASURING OF SAMPLES

The speed-button **Measure** or **Measure sample** item from menu **Measure** starts the measurement of a sample. First the method of measurement has to be selected from the list displayed on the desktop. Select the required method to activate the sample description entry form - **New sample description** - Picture 3.23.The number of displayed fields depends on the previous setup done on tabs **Sample description** and **Measurements methods**, therefore the picture 3.23 is only illustrative. All required information should be entered before **Inserting sample** in the measuring container to sample chamber. Ensure the lid is closed securely. Measurement starts by selecting the **Start measurement** button.
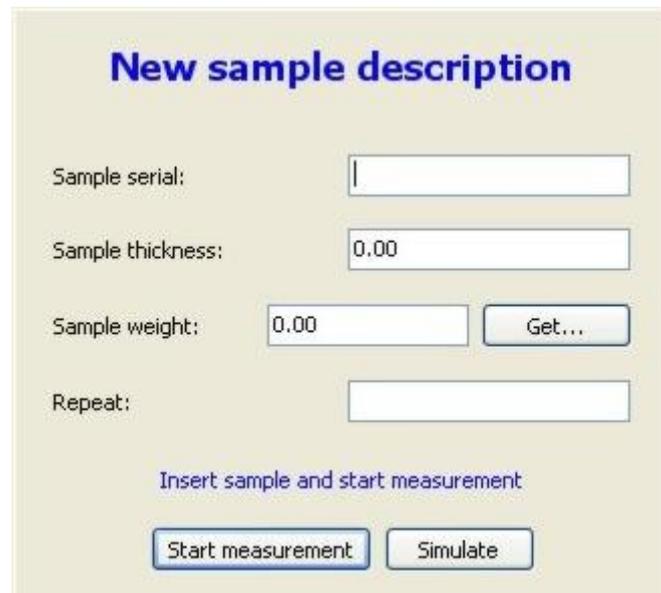
Picture 3.23

All fields with preset attributes **Allow empty** to **No** must be filled. If this is not done then selecting **Start measurement** only triggers a warning message box with the

message **Field must be filled:** Any field with **Field type Weight** is editable directly from the keyboard or to receive the actual weight from scale on line click button **Get…** For dust and geological samples, the net weight of the sample, excluding the container weight, is used. For online weighing, the scales are tarred with an empty container and the scales automatically strip the weight of the container.

When measurement starts an animated chart is displayed on the desktop accompanied with button **Stop** and progress bar on the right - picture. 3.24. The screen is similar to the calibration screen but with the addition of the label **Sample measurement progress**. The **X axis** scales energies in **keV** and **y** counts impulses **cnts** in spectral channels. All ROIs are highlighted in green – compare chapter 3.3.3..
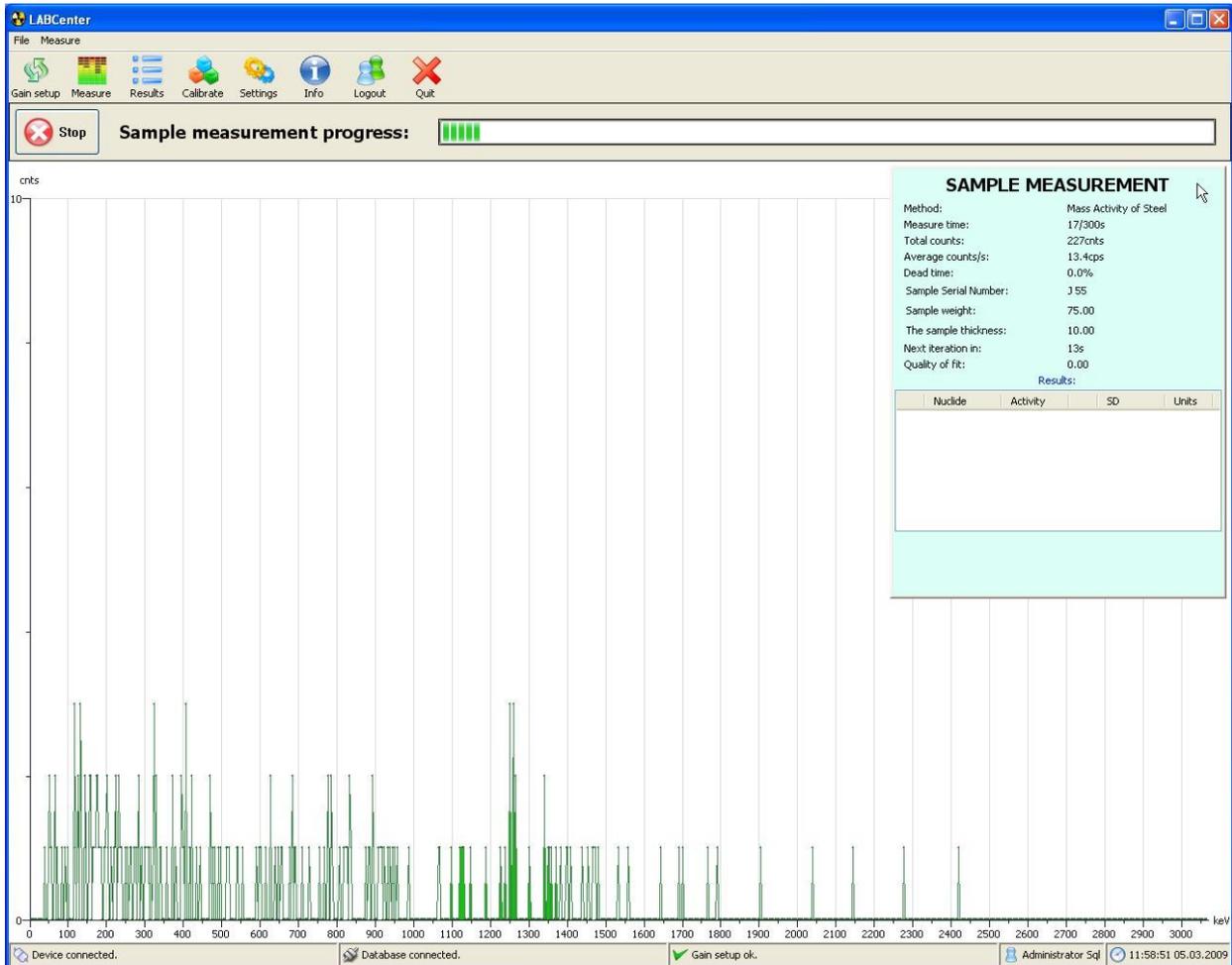
Picture 3.24

Pressing **Stop** interrupts the measurement at anytime. Any action can be aborted through the confirmation box **Sample measurement abort** with message **Do you really want to abort sample measurement?** and selection button **Yes**. Selecting **No** cancel this procedure and continue in regular measurement**.**

If the gamma-ray spectrometer is not connected, the error message appears: **Gamma measuring device must be connected to perform this operation!**. It is necessary to confirm the message by clicking the **OK** button and connect the spectrometer, check the wiring and selection of the correct device in **Settings** - **Measuring devices** - **Gamma measuring device**, resp. select and connect the correct device according to the serial number and confirm by clicking the **Apply** button.

The right upper corner of the spectral chart contains a popup window with **SAMPLE MEASUREMENT** in the header. It is an animated status screen with all important information updated every second during measurement. The following data is displayed:

- **Measure time:**   elapsed time / preset time
- **Total counts:**   number of all pulses registered in the whole spectrum
- **Average counts/s:**   average count rate
- **Dead time:**   actual dead time
- **Channel:**   position of the cursor in the spectrum
- **Energy:**   the related gamma energy to the position of the cursor in the spectrum
- **Counts:**   number of counts in the channel selected by cursor
- **Next iteration in:**   time to next preliminary evaluation
- **Quality of fit:**   measure of conformity between spectrum of the sample and spectra of the calibrated standards. This must be close to 1 (one). Poor conformity indicates the presence of another nuclide other than the one covered in the method or different geometry of measurement.

The following 4 fields appear in case of standard steel method. Those can vary according to the method settings. Also the structure of the Results varies according to the settings.

- **Method:**   name of current measurement method
- **Sample Serial Number:**   sample serial number or another name or label
- **Sample Weight:**   weight of the sample if used
- **The sample thickness:**   the sample thickness if used
- **Results:**   preliminary results. The evaluation is provided 30 seconds after the start of the measurement and thereafter every 10 seconds until the measurement is completed.   This preliminary evaluation offers a limited precision estimate of results before the final computation to help speed up the manager's decision process. The meaning of the values is described in the chapter 3.6.
- **SAMPLE OK or SAMPLE ABOVE LIMIT**   the final evaluation result of all selected methods. If **one** of methods give result the sample **is not** or **may not be** OK the second message appears. So the message **SAMPLE OK** appears only in case the spectrum agrees to the background spectrum + allowed amount of selected nuclides.

Successful measurement is announced with an acoustic tone and a box **Measurement completed** appears on desktop. All results are now final and are automatically saved to the database. Activating the OK button confirms the message **Sample measurement successfully completed.**. The sample can then be removed from the measuring sample chamber. The system is now ready to measure a fresh sample. The end of measurement must be confirmed by **OK** button. New window **Next sample** with question appears

The old user must log out before a new user can log on (see End Program section 3.7.2 below)

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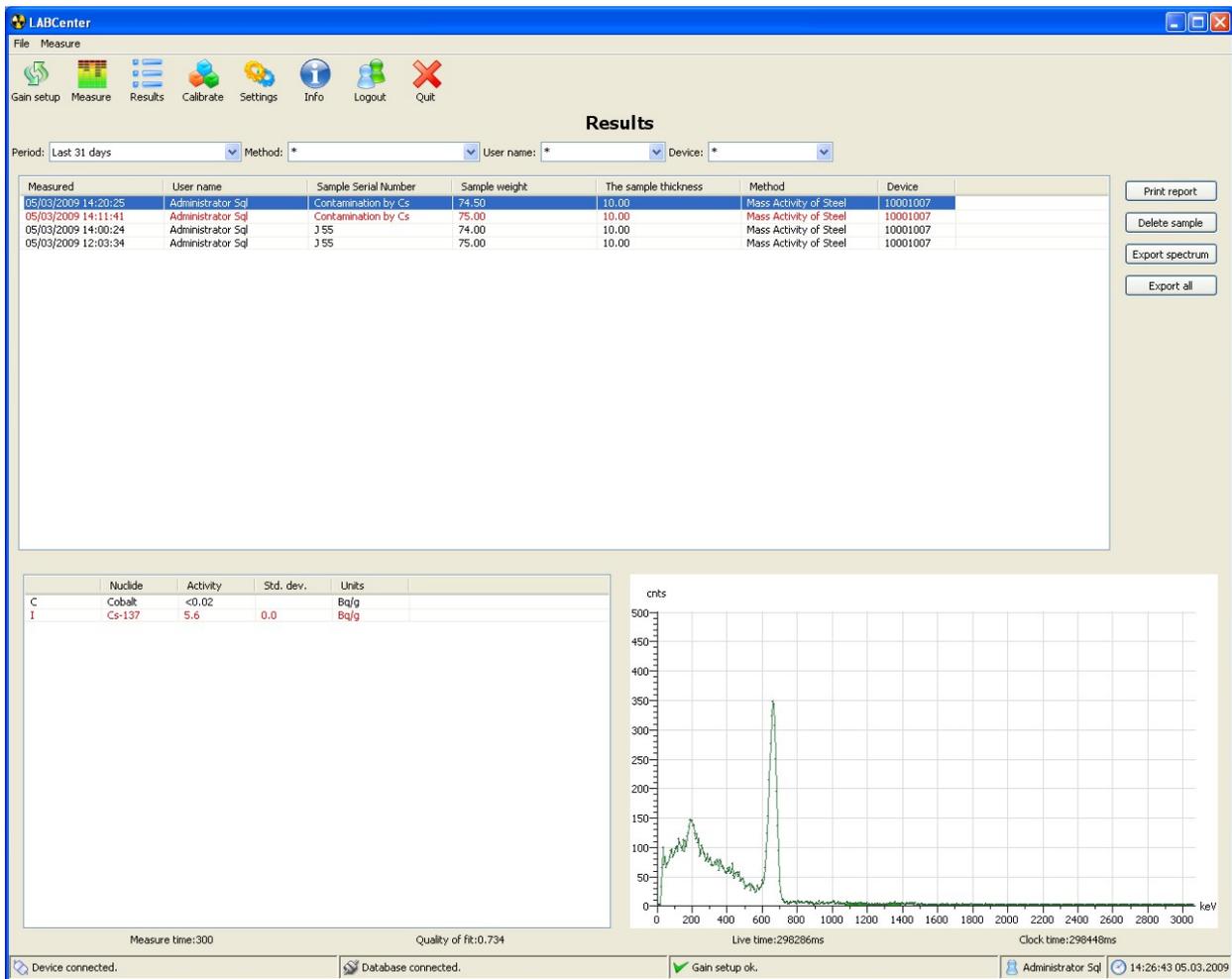
3.6. RESULTS

Picture 3.25

The results screen – picture 3.25 - displays immediately after login in to the database. User can also access the results via the speed button **Results** or by selecting **Results** from the **Measure** menu. The results screen consists of three windows. The upper window displays a list of all saved measurement results ordered by time of measurement. The time of measurement and the user name will help with orientation in database. The user can select any row from the list. Related results of the measurement selected will be displayed in the window on left bottom corner. Also the measured spectrum for the measurement selected is displayed in the third window on the bottom right.

The top row shows the measurement selection criteria. As can be seen in Picture 3.25, it is possible to select the results measured over a selected time period, by a selected method, by a selected user or instrument, if multiple instruments connected to a single computer are used. The drop-down menus always offer possible choices for selection.

Buttons on the right allows user to output important information from the database. It is possible to **print** results on predefined form. **Delete** item from the database and **export** measured spectra as well as the complete data record in any ASCII file.

The results are shown in some columns. The first one (no label) gives the flag "**C**" when this row is evaluated by LSQ method using **C**alibration or/and "**I**" when the evaluation is done by NA method via nuclide **I**dentification. The meaning of the following columns is clear, **Std. dev.** (**SD**) means Standard Deviation of the calculated activity calculated from the statistics of measurement and **Units** displays the units selected in chapter 3.3.5.

Note that activities below the detection limit are in **black** color, results with activities above the detection limit and below the followed limit are in **blue** color and results above the followed limit and results of NA method are in **red** color. The activity above the followed limit and/or presence of any nuclide out of calibration list caused message "**SAMPLE ABOVE LIMIT**" due to it is unexpected nuclide activity.

The **Results** tab can be replaced with a tab **Details** which are given detailed measurement information that may be important in non-standard cases:

- **Quality of fit:**   the quality of a fit parameter, which controls how the simulated spectrum coincides with the measured. Ideally reaches 1 compliant simulation reaches a value less than the 5th
- **Measure time:**   the set measuring time
- **Live time:**   live time measurement
- **Clock time:**   total time hourly measurements
- **Gain correction:**   calculated gain correction, applied only if there is a simulation of the measured spectra
- **Total counts:**   The sum of counts in all channels of the spectrum
- **Average counts/s:**   sum of pulses in all channels of the spectrum divided by the live time

The spectrum shown in the lower right field can be edited using the buttons to the right of him:

- Adjust the scale axes automatically so that it shows the whole spectrum
- increases graph by decreasing of the y-axis range
- reduced graph by increasing of the y-axis range
- Allows selection x-axis of the spectrum (mouse - press the left button = start of the selection, release the = button to end selection)
- scaling the x-axis across the spectrum
- switching linear and logarithmic y-axis scale
- switching X-axis unit scale between **keV** and channels (**ch**)
- Storage of spectrum in text format, each line = 1 channel

3.7. PROGRAM TERMINATION (ENDING THE PROGRAM)

3.7.1. INFO ABOUT THE PROGRAM

Click on **Info** button results to the window **Program information** appears on the screen. The SW version, creation date, server version and next info according to the Picture 3.26 are displayed. Those parameters have reason only for service purposes.

The only important item is the **Upgrade** button. Clicking on it causes the connection of PC to FTP server of producer (when PC connected to internet) and check if the new version of LabCenter SW is available. If no the window **No new SW** appears with message **No new software version available!**. Click on **OK** button closes the window.

Picture 3.26

In case of new SW version is available LabCenter offer its download and its installation. The asked password is **georadis**. The confirmation of ending of the current SW version is necessary during those operations. The user must have the right to install new SW on his PC otherwise the Windows system refuse the installation. It can be simply reached by starting the LabCenter SW not using shortcut on the desktop but from the Windows Explorer by finding the **labcenter.exe** file – usually in the folder: **C:/Program Files (x86)/LabCenter** – clicking on this file by right mouse button and selection **Run as Administrator**.

Click on **Close** button to closes the window.

3.7.2. LOGOUT AND PROGRAM TERMINATION

To change a user the old user must first logout. To logout choose **Logout** from the menu or via the speed button. A new popup window - picture 3.27 - **Logout** with control question **Do you really want to log out?** will display. Touching **Yes** switches to **Database login** and a new user can enter - see chapter. 3.2. **No** will abandon the action and leaves the old user active.

Picture 3.27

Program termination (ending the program) occurs after activating **Quit**. To end the program a confirmation popup must be activated - Picture 3.28.

Picture 3.28

3.8. ERRORS AND SYSTEM MESSAGES

Error message	Error description	Remedial measure
Device not connected!	The software has no connection with the equipment for measurement of gamma radiation spectra	Check the connection to the spectrometer via USB cable, select and connect the right equipment according to the serial number in menu: **Settings - Measuring devices - Gamma measuring device – RT-50**, confirm by **Apply** button
Database disconnected!	The software is not connected to the database server with program setting, calibration spectra and results of measurement	Log on the database server by procedure Login using one of the right name and password. The logging must be started up the SW via **Database setup**
Gamma measuring device must be connected to perform this operation!	The spectrometer is not connected or has no response. It is not possible to provide the selected function.	Check the connection to the spectrometer via USB cable and selection of the right equipment according to the serial number in menu: **Settings** - **Measuring devices** - **Gamma measuring device**, confirm by **Apply** button
Gain setup timeout!	Gain setup was not provided or it takes more than 24 hours since last setting	Start **Gain setup** procedure

| Gain setup error! Insert source and try again.	The Cs-137 was not found in the spectrum during Gain setup so the Gain setup was not provided	Check the presence of the Cs-137 test source in the sample chamber; it's orientation by the labeled side to the detector (down) and run the **Gain setup** again. If error repeats call the service.
Field must be filled:	The required field specified behind this message was not filled in	Fill in the specified field
Device communicating error. Params could not be read!	The spectrometer is not connected or does not respond	Check the connection to the spectrometer via USB cable and selection of the right equipment according to the serial number in menu: **Settings** - **Measuring devices** - **Gamma measuring device**, confirm by **Apply** button

3.9. CHECKING OF THE SYSTEM CONDITION

The RT-50 spectrometer is fully automatic system that adapts the internal parameters to the actual conditions of electronics or outside temperature. This is done during **Gain setup** and **Calibrate** procedure. Of course the system has limited range of parameters.

Also the detector can move the parameters due to the condition of the crystal, photomultiplier and their optical contact. The location of the detector inside the massive shielding in the laboratory ensure the best condition for the detector allowing it proper work for tens of years. But nevertheless an error can appear.

The following routine can give you an idea about the actual condition of the system. Check if the sample chamber is clean and no radiation sources are close to the RT-50 spectrometer.

1. Measure the calibration sample as a regular sample – if **Mass activity of steel** is one of the used methods measure the calibration sample of Co-60 in steel, otherwise use the calibration sample of mostly used method with the simplest spectrum (Cs-137, K-40, Co-60). Use the standard time of measurement, no quick preview, to obtain smooth spectrum.

2. Look to the view of spectra. When the detector is in perfect condition the full peak(s) must be inside the highlighted area(s). In case of Co-60 measurement both peaks should be there and the minimum between the peaks should reach as low as left border of the first peak or lower. See the picture 3.29.

3. The results must show only nuclide of measured sample (usually Co-60) and the activity must be in the region of ±3 Standard Deviations (SD) from the certified value (see Calibration Samples Protocol) corrected to the actual date using half-life of the nuclide. Compare the Manual, chapter 4.2.2 or 4.2.3. If no, run **Gain setup** and/or the **Calibration** according to the following steps and measure the sample again.

4. Look to the **Quality of fit** (the last item in the SAMPLE MEASUREMENT field). It should be lower than 5. The ideal value is 1, it can happen that it is lower than 1 – it does not matter. When this value exceeds 5, the **Calibration** is strongly recommended. Do not forget to run the **Gain setup** before the **Calibrate** procedure.
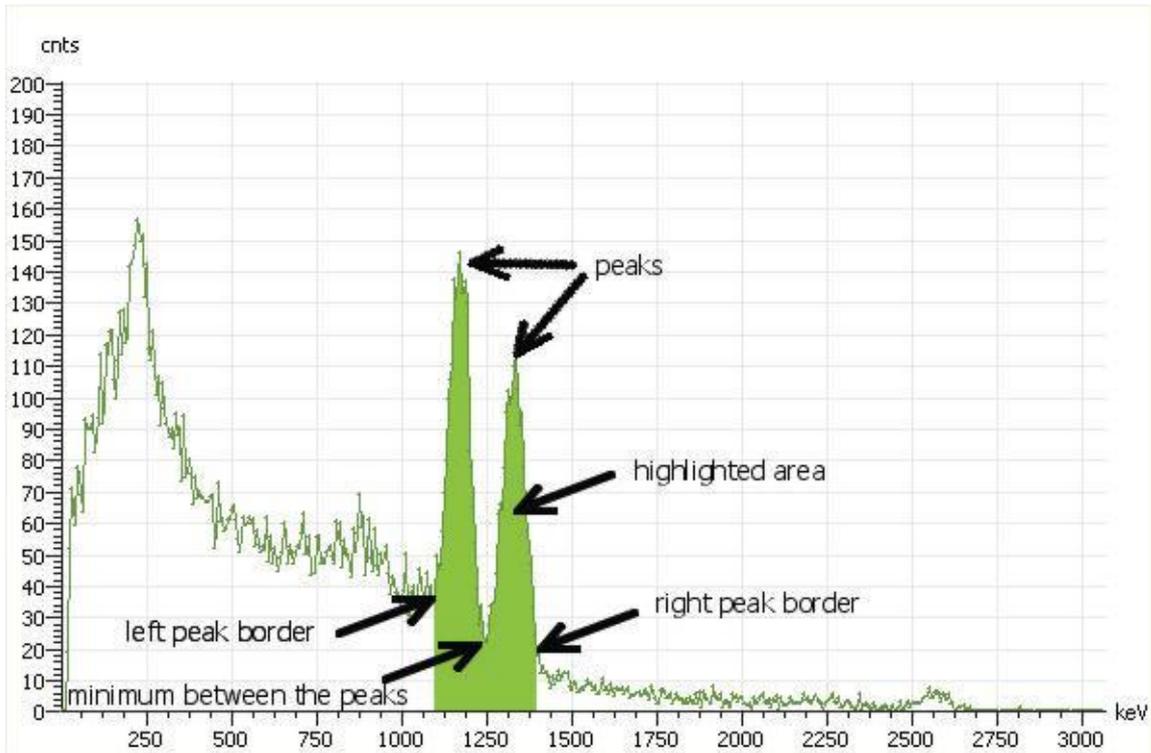
Picture 3.29

5. Go to **Results** menu and select the newest sample in the upper field. Than activate the **Details** list in the left bottom field of the LabCenter window. The **Quality of fit** is the first item there. The fifth item is **Gain correction**. This parameter was used during the simulation of the measured spectra from the calibration ones and should be close to value 1.00, let say 0.98 – 1.02. If not provide the **Gain setup** and repeat the measurement.

6. When Gain setup and Calibration is not necessary to provide or was finished **the results of the measurement must be OK** (otherwise the electronics or detector is unstable and must be completely replaced) and **the spectra view should looks like the picture above** – otherwise the detector lose the quality. The Nuclide Identification does not work precisely in that case and the block of electronics with the detector should be replaced soon. The calibration every month is recommended as well to avoid inaccurate results.

Notes:

During the Gain setup the following parameters are displayed on the screen:

High voltage – should be between 400 and 1000 Volts but close to the original value mentioned in the Quality Assurance PROTOCOL as HV Potentiometer: let say ± 10 Volts. If more, it means that the parameters of the detector or electronics were moved and was compensated by high voltage. No influence on the evaluation process.

ADC gain – fine setting of the gain varies in the range 0.95 – 1.05. If more, the next iteration of the Gain setup runs automatically and it is compensated by HV value.

ADC offset – gives the real shift between the zero of energy in keV and zero of voltage in mV. Any value is OK but normally about -40 mV.

Temperature – show the temperature on the processor measured by the internal thermometer. Not far from the laboratory temperature but the precision is poor.

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4. Technical information

4.1.   GAMMA RAY SPECTROMETER RT-50

4.1.1. DETECTOR AND ANALOG PROCESSOR

Type and size:	Sodium Iodine (thallium doted) NaI(Tl) volume 0.35l diameter 76 mm (3") height 76 mm (3"), Photomultiplier bialkali
Resolution:	Better then 9 % FWHM at energy 662 keV.
Energy range:	20 keV - 3.0 MeV
Reference source:	External, ^{137}Cs activity 9 kBq (approx. 0.25 mCi)
Shaping:	Bipolar, time constant 1 ms
Coarse gain:	Digitally controlled by High Voltage
Fine gain:	Digitally controlled +/- 3 % in 1024 gain steps
Spectrum stabilization:	Two point – offset and gain correction. Position 662 keV typically at 220th channel +/- 0.1 channel
	Possible also one point at 220th Channel.
High voltage:	Range 400 - 1000 V DC, digitally controlled in 4096 steps

4.1.2. ANALOG TO DIGITAL CONVERTER

Type:	Successive Approximation ADC, double buffered, high speed 1.5 ms with digital linearization
Number of channels:	1024 (Ch# 0,1 Life Time; ch# 2 - 1022 spectral data; ch# 1023 cosmic channel)
ADC Dead time:	Zero additional dead time (including memory cycle)
Integral nonlinearity:	max 0.1 %, full scale over top 99 % of range
Differential nonlinearity:	max 1 %, full scale over top 99 % of range
Lower threshold:	Digitally adjustable
Upper threshold:	Fixed to channel #1022, all pulses above this level are Cosmic and are accumulated in channel #1023
ADC Offset:	Digitally adjustable
Dead time correction:	Automatic, 0.1 % precision.
Communication interface:	USB type A(M) 2.0 / 1.0 / 1.1 compatible
Power requirements:	5 V / 100 mA DC, powered from USB

4.1.3. MECHANICAL

Shielding:	Steel, minimal thickness 85 mm, optionally lead
H x W x D:	770 mm x 360 mm x 620 mm (30"x14"x24")
Weight:	410 kg (900 lbs), with lead shielding 580 kg (1280 lbs)

4.1.4. ENVIRONMENTAL

Working temperature range:	0 to +40 °C
Store temperature:	-20 °C to + 60 °C

4.1.5. SOFTWARE

Operating system: Windows 2K, XP, Vista, 7, 8 or Linux with Kernel 2.6

Database server: Firebird SQL 2.0, ISO/IEC 9075-1, 14

4.2.   CALIBRATION WORKING STANDARDS

4.2.1. CESIUM TEST SAMPLE

There is delivered a little yellow knob containing 9 kBq (0.25 µCi) of Cs-137 for adjusting of the gain. Its activity is below a limit for radioactive materials adopted in the EU. The standard does not belong to category of radioactive materials in any respect of valid European jurisdiction. This knob is put into the orange rubber cylinder for better manipulation. Therefore it should be put into the sample chamber by the label down – towards the detector. Otherwise the distance of the source will increase for 2 cm and the efficiency of the measurement rapidly decreases. The Gain setup may end by the error message – compare the chapter 3.4.1.

4.2.2. STEEL STANDARDS

The Steel calibration standards are made from steel artificially contaminated with radionuclide Co-60 (Half life 1925 days). The activity of the standard was preciously measured by independent method and linked to the standards of the Czech certification authority. Basic set contains four standards with determined activity and one void sample for background determination. The standards are labeled with code. Level of activity is coded by letters (A – Z) followed with serial number. There is available a spreadsheet „Actual activity calculation.xls" on the installation CD in the subfolder Manuals. All activities can be recalculated to any suitable date. The user can use the following table:

Actual activity calculation for STEEL samples

Type correct value for Actual date, correct values for activities will be automatically generated.

Measured values must be between Minimal value and Maximal value

Actual activity [Bq/gram]	Sample TS-8	A 701-5 ^{60}Co	N 701-5 ^{60}Co	M 701-5 ^{60}Co	L 701-5 ^{60}Co	K 701-5 ^{60}Co
Reference date	1.1.2005	0.00	7.82	4.29	1.85	0.48
Actual date	10.2.2006	0.00	6.76	3.71	1.60	0.41
Standard deviation	[%]		1.6	1.8	3.9	5.0
Minimal value*	[Bq]	0.00	6.65	3.64	1.54	0.39
Maximal value*	[Bq]	0.02	6.87	3.77	1.66	0.44

* An average of ten measurements

To recalculate activity to new date a new **Actual date** has to be entered and all activities will be recomputed automatically.

Notice to Half life correction

Activity of any radioactive elements decreases in time. A new activity is computed using a simple formula.

As an example we use a sample marked N with certified activity 7.82 Bq/g.

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Time left between the reference date and a new actual date is 405 days.

Actual activity = (certified activity) x (2$^{-(time\ left/half\ life)}$) = 7.82 x (2$^{-(405/1925)}$) = 7.82 x 0.8643 = 6.76 Bq/g

4.2.3. SLAG AND DUST STANDARDS

Unlike steel calibration standards the slag / dust standards are made from milled regular slag with reasonable low concentration of natural radioisotopes. This raw material was artificially contaminated with specified radionuclide. A well homogenized compact mixture is mixed with the silicon rubber and poured in standard measuring cans. The standard volume 100 cm^3 and height 35 mm responds to 120 grams of material. The standards are labeled with the major radioisotope name and code **TS11_nn** where **nn** is the serial number of standard. For example **TS11_53**. All activities of standards can be recalculated in the spreadsheet „**activity.xls**" that is available on the installation USB memory in the subfolder Manuals. The tables for recalculation of activities of Slag standards follow.

Actual activity calculation for DUST calibration samples

Type correct value for Actual date, correct values for activities will be automatically generated.

Measured values must be between Minimal value and Maximal value

Actual activity [Bq/gram]	TS11 SN: 51 - 55	^{241}Am	^{60}Co	^{137}Cs	^{40}K	^{226}Ra	^{232}Th
Reference date	1.1.2007	29.40	6.88	16.00	15.05	15.46	8.10
Actual date	15.5.2007	29.38	6.56	15.87	15.05	15.46	8.10
Standard deviation	[%]	2.8	3.5	2.5	12.0	2.6	3.0
Minimal value*	[Bq]	28.57	6.33	15.47	13.25	15.06	7.86
Maximal value*	[Bq]	30.19	6.78	16.26	16.85	15.86	8.34

* An average of ten measurements

To recalculate activity to new date a new actual date has to be entered and all activities will be recomputed automatically.

4.2.4. GEOPHYSICAL STANDARDS

The geophysical standards are made from rock with the high concentration of a specific natural radioisotope. In case of Cs-137 there is used sand contaminated with Cs-137 from the area of Chernobyl.

There are two different measuring cans used for volumes 100 cm^3 and 200 cm^3. The effective height is then 35 mm respectively 30 mm and average weight 120 grams and 300 grams. The basic set includes the standards **K**, **U, Th** and if requested also **Cs-137**. The etalons are labelled by name of major nuclide, its activity or concentration, reference date, name **TS-15**, serial number of the set and mark of radioactive material. See following example:

All cans are carefully sealed to ensure a proper balance of daughter products. Recalculation of activities is also possible but for very long half times of natural radionuclide has no practical sense. Tables are in „**activity.xls**". The example follows:

Actual activity calculation for ROCK samples

Type correct value for Actual date, correct values for activities will be automatically generated.

Etalon TS-15								
Reference date	K40		Cs137		U		Th	
1.7.2006		Rel. SD [%]		Rel. SD [%]		Rel. SD [%]		Rel. SD [%]
^{40}K [%]	35.3	3.6	1	83.3				
^{40}K [Bq/kg]	11 200	3.6	300	83.3				
^{137}Cs [Bq/kg]			1 950	1.5				
U_e [ppm]					290	1.7	4	40.0
U_e [Bq/kg]					3 580	1.7	50	40.0
Th_e [ppm]							593	1.7
Th_e [Bq/kg]							2 400	1.7
Actual date	K40		Cs137		U		Th	
20.9.2006		Rel. SD [%]		Rel. SD [%]		Rel. SD [%]		Rel. SD [%]
^{40}K [%]	35	3.6	1	83.3				
^{40}K [Bq/kg]	11 200	3.6	300	83.3				
^{137}Cs [Bq/kg]			1 940	1.5				
U_e [ppm]					290	1.7	4	40.0
U_e [Bq/kg]					3 580	1.7	50	40.0
Th_e [ppm]							593	1.7
Th_e [Bq/kg]							2 400	1.7

4.3. DATA FORMAT

All data is stored in the main database file **Lab.fdb**. Its structure is flexible and reflects customer's setup. The Lab.fdb is controlled by SQL server and can be simply accessed or modified with any SQL browser. We recommend freeware program **FlameRobin**.

The manufacturer's selection of SQL database protocol is to give the customer an indirect full access to the stored data and to allow integration (if required) of the RT-50 Lab into the customer's own database/network structures. Copying of the Lab.fdb to different locations allows the user to simply backup the database and protect the data.

All questions regarding databases please forward to:

service@georadis.com

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4.4. CORRECTION FILE FORMAT

The correction file could be used for any type of correction of the activity evaluation. It is used in case that the geometry of the measured sample and calibration samples are not exactly the same and the activity can be re-calculated according to the known formula or table found from the experiment. The formula must be used for table calculation to allow **LabCenter** SW only one correction format.

The file with correction table must be in the text only form.

The first row has only one number - ratio between the parameter of the calibration sample and entered unit. For instance calibration sample for STEEL mass activity measurement has the thickness 10 mm and the thickness is entered in mm so the ratio is 10/1=0.1.

The second row starts: "Param:" followed by the name of nuclides for which the corrections are calculated. The names must be typed in the same form as is used in Setting - List of Nuclides. When this row is missing so the first correction column is applied to the all found nuclides.

The followed rows have some numbers separated by tabulator. The first number is the value of the parameter used for correction (sample thickness) divided by this value for the calibration sample (so the value for calibration sample is any time 1) while the next numbers are a relative efficiency of the measurement in comparison to the calibration sample (so the value for calibration sample is 1 again). The order of values agrees with the order of the nuclides in the second row. The example of the thickness correction file follows:

```
0.1
Param: Co-60 Am-241 Cs-137
0.3 0.7727 0.2966 0.6084
0.4 0.8042 0.3667 0.6461
0.5 0.8360 0.4359 0.6800
0.6 0.8680 0.5034 0.7122
0.7 0.9001 0.5688 0.7437
0.8 0.9325 0.6317 0.7749
0.9 0.9650 0.6918 0.8061
1   0.9977 0.7493 0.8375
1.1 1.0306 0.8041 0.8693
1.2 1.0637 0.8565 0.9013
1.3 1.0970 0.9065 0.9338
1.4 1.1305 0.9543 0.9667
1.5 1.1642 1.0000 1.0000
1.6 1.1981 1.0437 1.0338
1.7 1.2322 1.0857 1.0680
1.8 1.2664 1.1258 1.1027
1.9 1.3009 1.1644 1.1379
2   1.3355 1.2014 1.1736
2.1 1.3703 1.2370 1.2097
2.2 1.4054 1.2713 1.2462
2.3 1.4406 1.3043 1.2832
2.4 1.4760 1.3360 1.3206
2.5 1.5116 1.3666 1.3584
2.6 1.5474 1.3962 1.3966
2.7 1.5833 1.4247 1.4352
2.8 1.6195 1.4522 1.4743
2.9 1.6559 1.4788 1.5136
```

```
3   1.6924 1.5046 1.5534
3.1 1.7292 1.5295 1.5935
3.2 1.7661 1.5536 1.6339
3.3 1.8032 1.5769 1.6747
3.4 1.8406 1.5995 1.7157
3.5 1.8781 1.6214 1.7571
3.6 1.9158 1.6427 1.7988
3.7 1.9537 1.6634 1.8407
3.8 1.9918 1.6834 1.8829
3.9 2.0300 1.7028 1.9254
4   2.0685 1.7218 1.9681
4.1 2.1072 1.7401 2.0111
4.2 2.1460 1.7580 2.0543
4.3 2.1851 1.7754 2.0977
4.4 2.2243 1.7923 2.1413
4.5 2.2637 1.8088 2.1852
4.6 2.3033 1.8248 2.2292
4.7 2.3431 1.8405 2.2733
4.8 2.3831 1.8557 2.3177
4.9 2.4233 1.8705 2.3622
5   2.4637 1.8850 2.4069
5.1 2.5043 1.8992 2.4517
5.2 2.5451 1.9129 2.4967
5.3 2.5860 1.9264 2.5418
5.4 2.6272 1.9395 2.5870
5.5 2.6685 1.9523 2.6324
5.6 2.7100 1.9649 2.6778
5.7 2.7518 1.9771 2.7234
5.8 2.7937 1.9891 2.7691
5.9 2.8358 2.0008 2.8148
6   2.8781 2.0122 2.8607
```

4.5.   PROTOCOL TEMPLATE

The protocol templates are located in the subfolder
local/_language_**/reports/**_geometry_**/** of the **C:\Program Files (x86)\LabCenter** folder.
The user can them modify according to his needs due to those are in HTML format.
The links to the variables must be preserved to hold relation to the database. The view
of basic STEEL protocol follows on the next page:

SAMPLE MEASUREMENT REPORT

12.12.2018 10:31:49

Results

User name:	Zeman Alois	Measuring device:	10001007
Sample serial number:	72833	Sample weight:	274.20 g
Sample thickness:	30.00	Measurement repeat:	$(REPEAT)
Measurement time:	300 s	Dead time:	0.00 %
Gain correction:	1.00	Quality of fit:	0.47
Total counts:	2103	Average counts:	7.05 cps
Live time:	298420192.00	Clock time:	298444640.00

SAMPLE OK

SPECTRAL ANALYSIS RESULTS

	NUCLIDE	ACTIVITY	ALARM LIMIT
1	Cobalt	$\leq$ 0.01 Bq/g	0.10 Bq/g
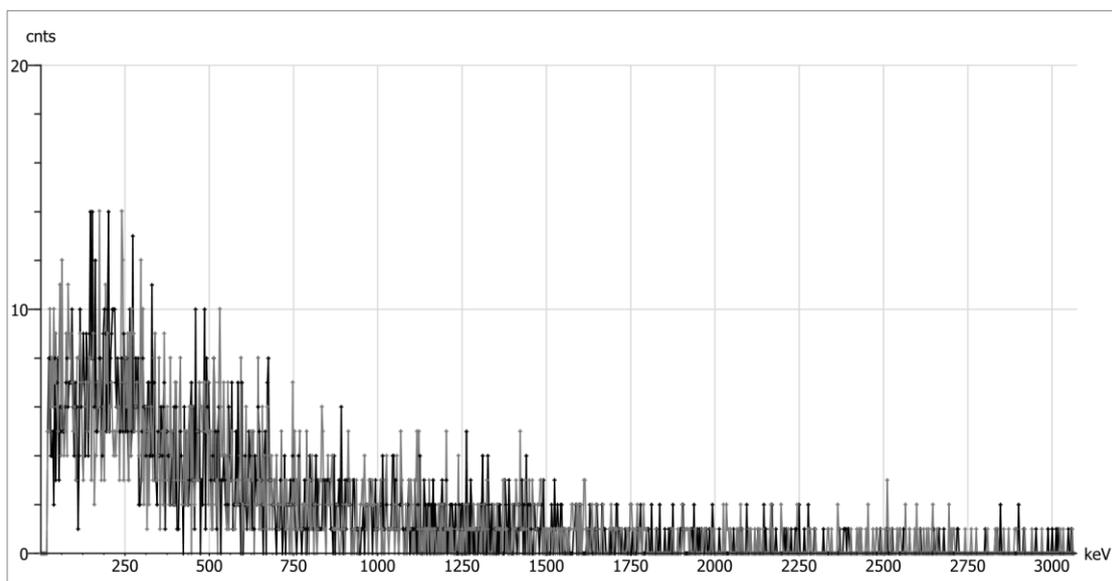
5. Enhanced software options

The more programs are stored on the installation CD for enhanced use of LabCenter SW. The installation SW itself is in the folder **labcenter** of the installation CD. The next folders named **develop**, **utility** and **video** are there as well. The example of software for external communication with database designated for software engineers who supply the data transmission inside the internal net of the user is in the folder **develop**. The user instructions are there too. The folder **utility** contents installation files of useful freeware and folder **video** contents the file with guide for mechanical completion of the RT-50 spectrometer.

5.1. USEFUL FREEWARE

The folder **utility** contents 5 installation files of freeware useful for LabCenter use. Those are:

5.1.1. ACROBAT READER

The mostly spread freeware for displaying the files in **PDF** format. It is important for instance for reading the User manual in PC. It is available after the LabCenter installation from the **Start** menu by selection **Programs** - **Georadis LabCenter** - **Docs** - **Manual Lang**, where Lang means the shortcut of the manual language.

The newest version or different language versions are available on: http://get.adobe.com/cz/reader/.

5.1.2. DECAY

Decay is software including the overview of nuclides and their properties. Interested in extension of list of nuclides in methods the user can get all the needed info in this database. The calibration sample with known activity of this nuclide and selected geometry is necessary for its measurement.

The software is available on: https://maxwell.ict.griffith.edu.au/ch/Downloads/RadDec.html.

5.1.3. FLAME ROBIN

Flame Robin is software for operation of SQL database. It is useful for software engineers that want to get the detail info about the LabCenter database to include them to the company info system.

The software is available on: http://sourceforge.net/projects/flamerobin/files/

5.1.4. PDFCREATOR

PDF Creator is software that allows the export of any file to PDF format. The new printer PDF Creator appears in the computer after its installation. The document is exported to PDF via printing it by this printer. The file name and folder should be selected during this operation.

That is useful on the computers without printer for storage of the copies of various files like Protocols about the measurement and similar ones.

The software is available on: http://www.pdfcreator.com.

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5.1.5. POEDIT

PO Edit is software for creation of the software translation. The **LabCenter** has the subfolder **locale** with subfolders of various languages according to the Windows habits. Each of them contents file **labcenter.po** that can be simply translated using **POEdit** freeware. The new file **labcenter.mo** is automatically generated after saving of the translation. This file starts to be active after the selection **Setting** – **Other setting** – **Language** and **LabCenter** restart. All software messages and reports are taken from this file. The detail manual is stored in English text file in the folder POEdit on CD due to the translation is provided from the basic language of the software – English.

The software is available on: http://poedit.net/.

5.2. SOFTWARE FOR EXTERNAL COMMUNICATION WITH THE DATABASE

The folder **develop** contents the **LabCenterInt.zip** file with the examle of software for external communication with SQL database **labcenter** in subfolder **src**. The source code in C++ is in the same folder. The SW description with possibilities of use is in subfolder **doc**.

The SW is designated for software engineers who supply the data transmission inside the internal net of the user.

5.3. MECHANICAL COMPLETATION OF SPECTROMETER RT-50

The video folder contents the instruction film how to complete RT-50 together. The file has Windows Meta Video (WMV) format that can be run on the computer with basic Windows installation. No special SW is necessary for viewing it.

The video film is made out for the users which do not order the installation and training due to any reasons.